Precision Ball Screws
DIN Standard Compliant Ball Screw

EB series / EP series

Compliant with Mounting Dimensions of DIN 69051
Preloaded or with Axial Clearance
Precision grade Cp/Ct ISO 3408-3 compliant

For details, visit THK at **www.thk.com**
*Product information is updated regularly on the THK website.

THK CO., LTD.
TOKYO, JAPAN

CATALOG No.335-2E

Precision Ball Screws DIN 69051 compliant
DIN Standard Compliant Ball Screw
Models EBA, EBB, EBC, EPA, EPB and EPC

Structure and Features

In the DIN standard compliant Ball Screw, balls under a load roll in the raceway cut between the screw shaft and the nut while receiving the axial load, travel along the groove of a deflector embedded inside the nut to the adjacent raceway, and then circulate back to the loaded area. Thus, the balls perform infinite rolling motion.
Two types of nuts are available: model EB of oversized-ball preload type or non-preloaded type, and model EP of offset preloaded type.

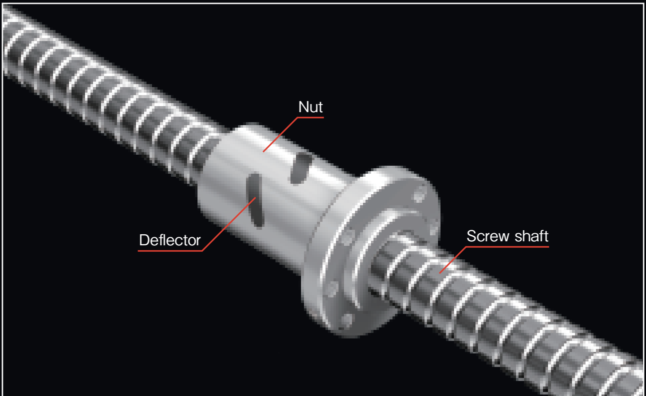


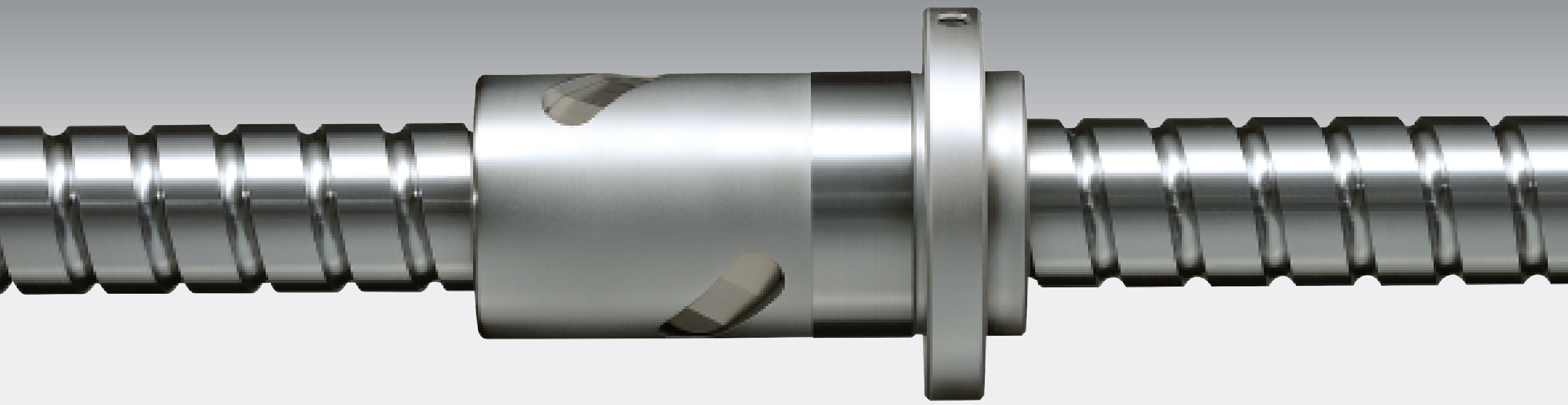
Fig. 1 Structure of a single nut with deflector

[Compact]

This Ball Screw is compactly built. Because of an internal circulation system using deflectors, the outer diameter of the nut is 70 to 80% of the conventional double nut and the overall nut length is only 60 to 80% of the return pipe nut.

[Compliant with a DIN standard]

The nut flange shape, mounting holes and rated load are compliant with DIN69051.

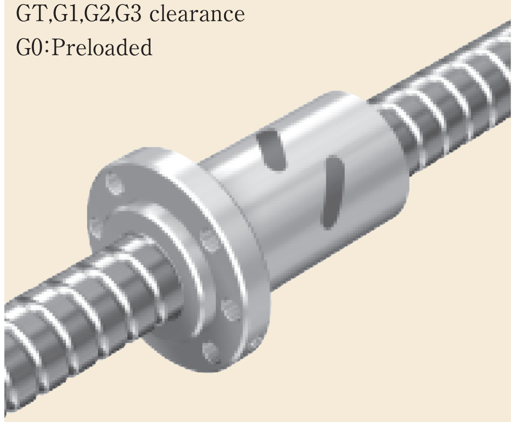


Types and Features

Models EBA/EPA Form A [Flange shape: round-flange type]

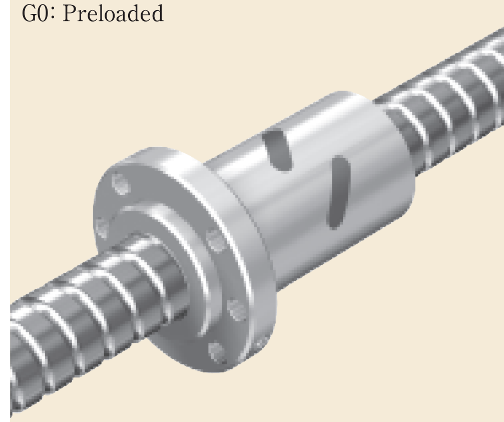
EBA

GT,G1,G2,G3 clearance
G0:Preloaded



EPA

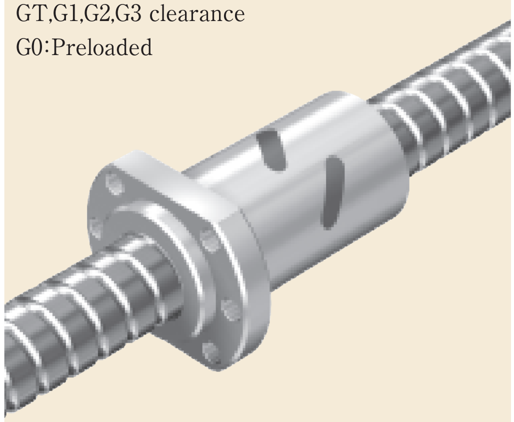
G0: Preloaded



Models EBB/EPB Form B [Flange shape: type with two flats]

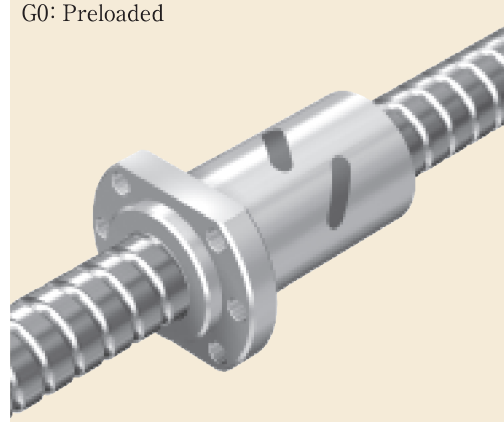
EBB

GT,G1,G2,G3 clearance
G0:Preloaded



EPB

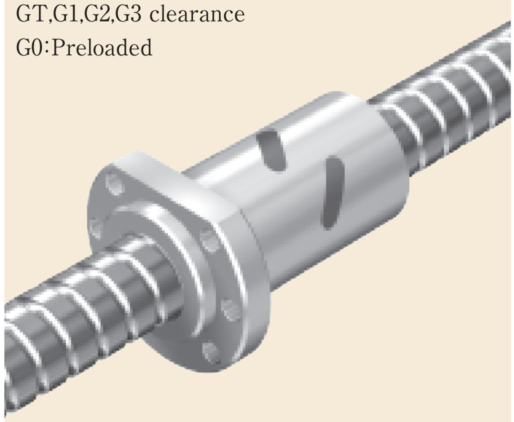
G0: Preloaded



Models EBC/EPC Form C [Flange shape: type with one flat]

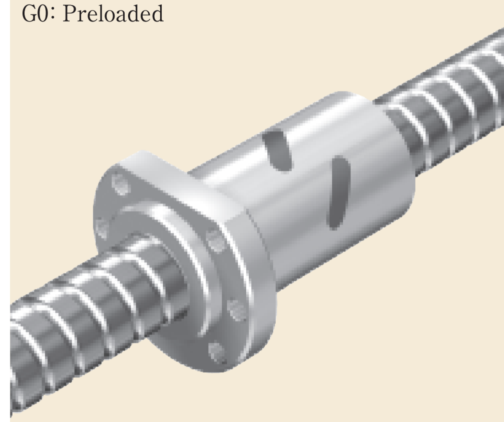
EBC

GT,G1,G2,G3 clearance
G0:Preloaded



EPC

G0: Preloaded



Screw Shaft Selection

Available Diameter / Lead Combination

The tables below indicate the standard combinations of the screw shafts and leads.

Table1 EB / EP series (ground)

Unit:mm

Precision class		C0, C1, C2, C3, C5, C7		
Ball screw lead		5	10	20
Screw shaft diameter	16	●	–	–
	20	●	–	–
	25	●	●	–
	32	●	●	–
	40	●	●	○
	50	○	●	○
	63	–	●	○

○ only EB series

Table2 EB / EP series (precision rolled)

Unit:mm

Precision class		Cp3, Cp5, Ct5, Ct7		
Ball screw lead		5	10	20
Screw shaft diameter	16	●	–	–
	20	●	–	–
	25	●	●	–
	32	●	●	–
	40	–	●	–
	50	–	–	–
	63	–	–	–

Limitations of Screw Shaft Lengths

Table 3 shows the maximum manufacturing lengths of precision Ball Screws by accuracy grades.

Table3 Maximum manufacturing lengths of precision Ball Screws

Unit:mm

Shaft diameter	Ground shaft						Precision rolled shaft			
	C0	C1	C2	C3	C5	C7	Cp3	Cp5	Ct5	Ct7
16	620	730	900	1050	1100	1400	1050	1100	1100	1400
20	820	950	1200	1400	1600	1800	1400	1600	1600	1800
25	1100	1400	1600	1800	2000	2400	1800	2000	2000	2400
32	1600	1800	2200	2500	2800	3200	2500	2800	2800	3200
40	2000	2400	2900	3400	3700	4300	3400	3700	3700	4300
50	2000	3100	3800	4500	5000	5800	–	–	–	–
63	2000	4000	5200	5800	6700	7700	–	–	–	–

Table 4 shows the maximum screw shaft lengths by screw shaft diameter and axial clearance.

Table4 Maximum manufacturing lengths of precision Ball Screws with axial clearances

Unit:mm

Shaft diameter	Clearance GT		Clearance G1		Clearance G2		
	C0 to C3,Cp3	C5,Cp5,Ct5	C0 to C3,Cp3	C5,Cp5,Ct5	C0 to C3,Cp3	C5,Cp5,Ct5	C7,Ct7
16	500	400	500	500	700	600	500
20,25	800	700	800	700	1000	1000	1000
32	900	800	1100	900	1400	1200	1200
40	1000	800	1300	1000	2000	1500	1500
50,63	1200	1000	1600	1300	2500	2000	2000

*When manufacturing Ball Screws of precision-grade accuracy C7 (Ct7) with clearance GT or G1, the resulting clearance may be partially negative.

Axial Clearance of the Precision Ball Screw

Table 5 shows the axial clearance of the precision Ball Screw.

Table5　Axial Clearance of the Precision Ball Screw

Unit:mm

Clearance symbol	G0	GT	G1	G2	G3
Axial clearance	0 or less	0 to 0.005	0 to 0.01	0 to 0.02	0 to 0.05

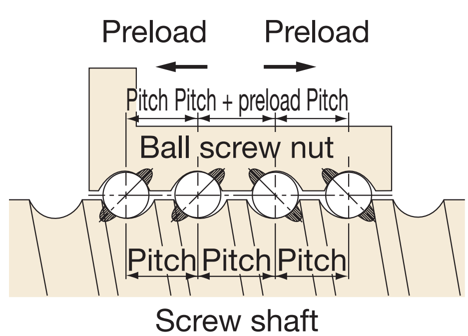
Preload (G0 clearance)

Preload eliminates the axial clearance of the ball screw and improves its rigidity.

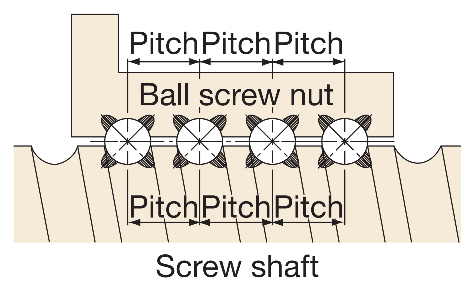
Preload methods

(A) Preload by offset-pitch method: The pitch is shifted at the central part of the nut to create the required preload.

(B) Oversized-ball preload: The nut is filled with balls in a larger diameter to achieve 4-point contact with the raceways.



EPA/EPB/EPC



EBA/EBB/EBC

Table6　Preload of the Precision Ball Screw

Manufacturing method		Ground	Precision rolled		
Accuracy grade		C0 to C7	Cp3,Cp5	Ct3,Ct5	Ct7
EPA/EPB/EPC	(A)Pitch shifted	0.05 Ca	0.05 Ca	0.05 Ca	——
EBA/EBB/EBC	(B)Ball selection	(0.02 Ca)	(0.02 Ca)	Without clearance	Without clearance

Accuracy of the Ball Screw

The accuracy grades of the precision ball screws are controlled in accordance with the ISO 3408-3 and Japanese Standards JIS B1192-1997.

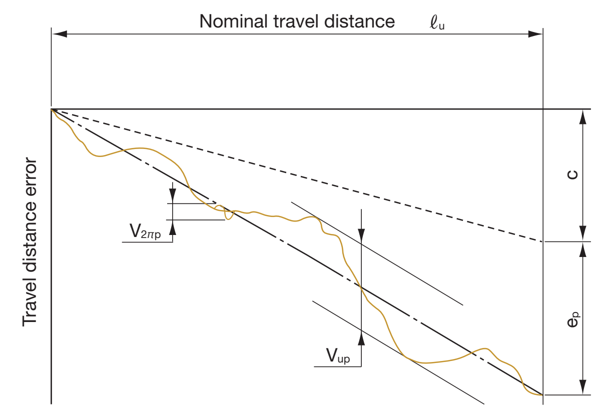


Fig. 2 Permissible travel distance error and travel variation in relation to the nominal travel distance

e_p :Representative travel distance error. The difference between the representative travel distance and reference travel distance.

V_{up} :Fluctuation: The maximum width of the actual travel distance between two straight lines drawn in parallel with the representative travel distance.

$V_{2\pi p}$:Fluctuation/2pi: A fluctuation in one revolution of the screw shaft.

V_{300p} :Fluctuation/300: Indicates a fluctuation against a given thread length of 300 mm.

C :Travel compensation. The difference between the specified travel and nominal travel distance within the useful travel.

Table7 Tolerance on specified travel ± e_p and permissible travel variation V_{up} in relation to the nominal travel ℓ_u for positioning ball screws.

Unit:μm

Accuracy Grades		C0		C1		C2		C3		C5		Cp3		Cp5	
Normal travel ℓ_u[mm] Above	Or less	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}
—	100	3	3	3.5	5	5	7	8	8	18	18	12	12	23	23
100	200	3.5	3	4.5	5	7	7	10	8	20	18	12	12	23	23
200	315	4	3.5	6	5	8	7	12	8	23	18	12	12	23	23
315	400	5	3.5	7	5	9	7	13	10	25	20	13	12	25	25
400	500	6	4	8	5	10	7	15	10	27	20	15	13	27	26
500	630	6	4	9	6	11	8	16	12	30	23	16	14	32	29
630	800	7	5	10	7	13	9	18	13	35	25	18	16	36	31
800	1000	8	6	11	8	15	10	21	15	40	27	21	17	40	34
1000	1250	9	6	13	9	18	11	24	16	46	30	24	19	47	39
1250	1600	11	7	15	10	21	13	29	18	54	35	29	22	55	44
1600	2000	—	—	18	11	25	15	35	21	65	40	35	25	65	51
2000	2500	—	—	22	13	30	18	41	24	77	46	41	29	78	59
2500	3150	—	—	26	15	36	21	50	29	93	54	50	34	96	69
3150	4000	—	—	30	18	44	25	60	35	115	65	62	41	115	82
4000	5000	—	—	—	—	52	30	72	41	140	77	—	—	—	—
5000	6300	—	—	—	—	65	36	90	50	170	93	—	—	—	—
6300	8000	—	—	—	—	—	—	110	60	210	115	—	—	—	—

Table8 Permissible travel variation in relation to one rotation $V_{2\pi p}$ and permissible travel variation over 300 mm travel V_{300p} for positioning ball screws.

Unit:μm

Accuracy Grades	C0		C1		C2		C3		C5		Cp3		Cp5	
	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$	V_{300p}	$V_{2\pi p}$
Permissible value	3.5	3	5	4	7	5	8	6	18	8	12	6	23	8

Table9 Tolerance on specified travel e_p and permissible travel variation over 300 mm travel V_{300p} for transport ball screws.

Unit:μm

Accuracy Grades	C7	Ct3	Ct5	Ct7
e_p	±50/300mm	$2 \cdot \ell_u / 300 \cdot V_{300p}$	$2 \cdot \ell_u / 300 \cdot V_{300p}$	$2 \cdot \ell_u / 300 \cdot V_{300p}$
V_{up}	not defined	not defined	not defined	not defined
V_{300p}	not defined	12	23	52
$V_{2\pi p}$	not defined	not defined	not defined	not defined

Mounting surface Accuracy

Grade C

The accuracy of the Ball Screw mounting surface complies with the JIS standard (JIS B 1192-1997).

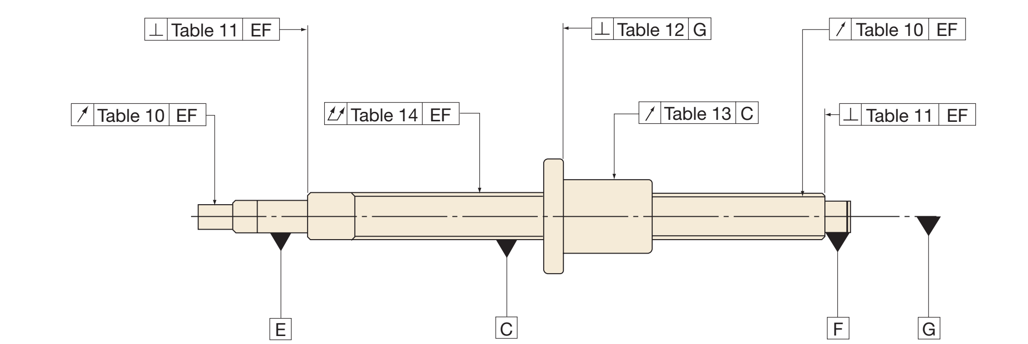


Fig.3 Accuracy of the Mounting Surface of the Ball Screw with grade C

Radial Runout of the Circumference of the Raceway Threads and Radial Runout of the Circumference of the Motor-mounting shaft-end in Relation to the Bearing Journals of the Screw Shaft (see Table10)

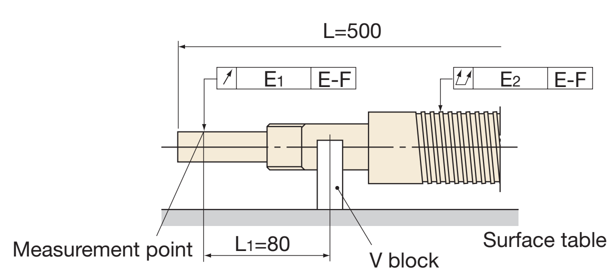
Table10 Radial Runout of the Circumference of the Raceway Threads * and Radial Runout of the Circumference of the Motor-mounting shaft-end in Relation to the Bearing Journals of the Screw Shaft

Unit:μm

Screw shaft outer diameter [mm]		Runout (maximum)					
Above	Or less	C0	C1	C2	C3	C5	C7
12	20	4	6	8	9	12	14
20	32	5	7	9	10	13	20
32	50	6	8	10	12	15	20
50	80	7	9	11	13	17	20

* Note)
The measurements on these items include the effect of the runout of the screw shaft diameter.
Therefore, it is necessary to obtain the correction value from the overall runout of the screw shaft axis, using the ratio of the distance between the supporting point and measurement point to the overall screw shaft length, and add the obtained value to the table above.

Example: model No. EPB2005-6RRGO+500LC5



$$E_1 = e + \Delta e$$

$$\Delta e = \frac{L_1}{L} \times E_2$$

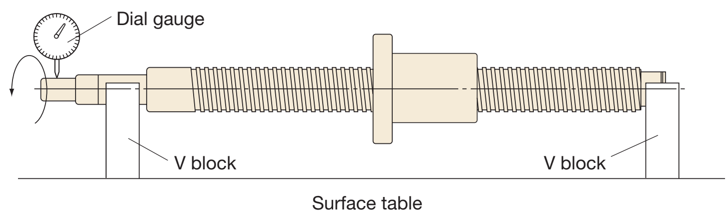
$$= \frac{80}{500} \times 0.06$$
$$= 0.01$$

$$E_1 = 0.012 + 0.01$$
$$= 0.022$$

e :Standard value in Table10 (0.012)
Δe :Correction value
E_2 :Overall radial runout of the screw shaft axis in Table14 (0.06)

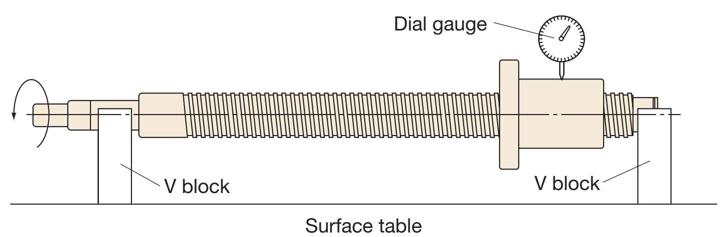
Radial Runout of the Circumference of the Motor-mounting shaft-end in Relation to the Bearing Journals of the Screw Shaft

Support the end journal of the screw shaft on V blocks. Place a probe on the circumference of the motor-mounting shaft-end and record the largest difference on the dial gauge as a measurement while rotating the screw shaft through one revolution.



Radial Runout of the Circumference of the Raceway Threads in Relation to the Bearing Journals of the Screw Shaft

Support the end journal of the screw shaft on V blocks. Place a probe on the circumference of the nut, and record the largest difference on the dial gauge as a measurement while rotating the screw shaft by one revolution without rotating the nut.



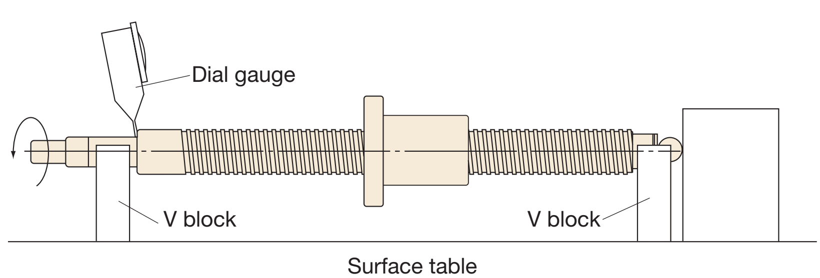
Perpendicularity of the End Journal of the Screw Shaft to the Bearing Journals (see Table11)

Table11 Perpendicularity of the End Journal of the Screw Shaft to the Bearing Journals

Unit:μm

Screw shaft outer diameter [mm]		Perpendicularity (maximum)					
Above	Or less	C0	C1	C2	C3	C5	C7
12	20	2	3	3	4	5	7
20	32	2	3	3	4	5	7
32	50	2	3	3	4	5	8
50	80	3	4	4	5	7	10

Support the bearing journal portions of the screw shaft on V blocks. Place a probe on the screw shaft's supporting portion end, and record the largest difference on the dial gauge as a measurement while rotating the screw shaft through one revolution.



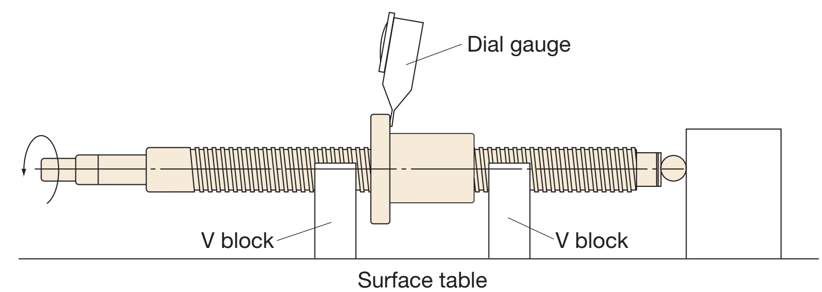
Perpendicularity of the Flange Mounting Surface of the Screw Shaft to the Bearing Journals (see Table12)

Table12 Perpendicularity of the Flange Mounting Surface of the Screw Shaft to the Bearing Journals

Unit:μm

Nut diameter [mm]		Perpendicularity (maximum)					
Above	Or less	C0	C1	C2	C3	C5	C7
20	32	5	6	7	8	10	14
32	50	6	7	8	8	11	18
50	80	7	8	9	10	13	18
80	125	7	9	10	12	15	20

Support the thread of the screw shaft on V blocks near the nut. Place a probe on the flange end, and record the largest difference on the dial gauge as a measurement while simultaneously rotating the screw shaft and the nut through one revolution.



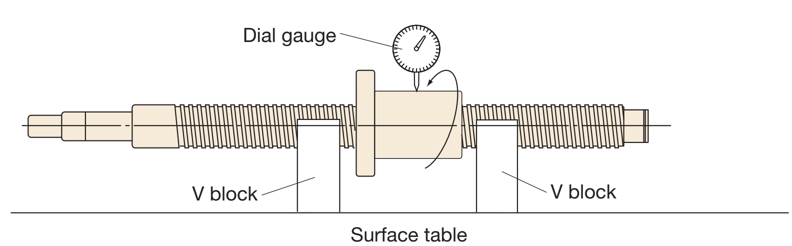
Radial Runout of the Nut Circumference in Relation to the Screw Shaft Axis (see Table13)

Table13 Radial Runout of the Nut Circumference in Relation to the Screw Shaft Axis

Unit:μm

Nut diameter [mm]		Runout (maximum)					
Above	Or less	C0	C1	C2	C3	C5	C7
20	32	6	7	8	10	12	20
32	50	7	8	10	12	15	30
50	80	8	10	12	15	19	30
80	125	9	12	16	20	27	40

Support the thread of the screw shaft on V blocks near the nut. Place a probe on the circumference of the nut, and record the largest difference on the dial gauge as a measurement while rotating the nut through one revolution without rotating the screw shaft.



Overall Radial Runout of the Screw Shaft Axis (see Table14)

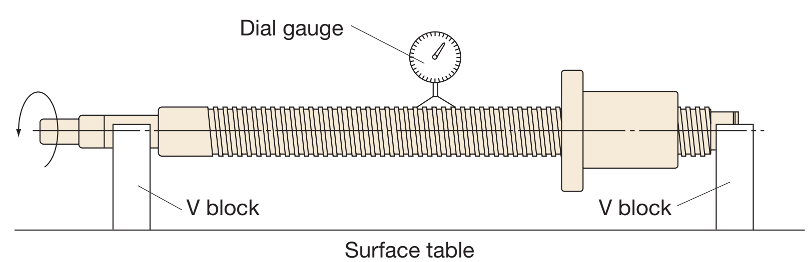
Table14 Radial Runout of the Screw Shaft Axis

Unit:μm

Accuracy Grades		C0				C1				C2				C3				C5			
Screw shaft outer diameter [mm]	Above	12	20	32	50	12	20	32	50	12	20	32	50	12	20	32	50	12	20	32	50
	Or less	20	32	50	80	20	32	50	80	20	32	50	80	20	32	50	80	20	32	50	80
Screw shaft length [mm]: —	125	15				15				17				20				35			
125	200	20	15			20	15			22	17			25	20			40	35		
200	315	20	20			25	20			27	25			30	30			45	40		
315	400	25	20	15		30	25	20		35	30	22		40	35	25		55	45	35	
400	500	35	25	20		40	30	25		45	35	27		50	40	30		60	50	45	35
500	630	40	30	20	15	45	35	25	20	50	40	30	25	55	45	35	30	75	60	50	40
630	800	50	35	25	20	60	40	30	25	65	47	35	30	70	55	40	35	90	70	55	45
800	1000	65	45	30	25	75	55	40	30	80	60	45	35	95	65	50	40	120	85	65	50
1000	1250	85	55	40	30	95	65	45	35	107	75	52	40	120	85	60	45	150	100	75	60
1250	1600	110	70	50	40	130	85	60	45	145	97	67	50	160	110	75	55	190	130	95	70
1600	2000		95	65	45		120	80	55		130	87	62		140	95	70		170	120	85
2000	2500							100	70			110	77			120	85			150	110
2500	3150							130	90			145	100			160	110			200	140
3150	4000								120			180	135			220	150			260	180
4000	5000												160				200				240
5000	6300																				310
Above	Or less																				

※C7 not defined

Support the supporting portion of the screw shaft on V blocks. Place a probe on the circumference of the screw shaft, and record the largest difference on the dial gauge at several points in the axial directions as a measurement while rotating the screw shaft through one revolution.



Grade Cp, Ct

The accuracy of the Ball Screw mounting surface complies with the ISO standard (ISO 3408-3).

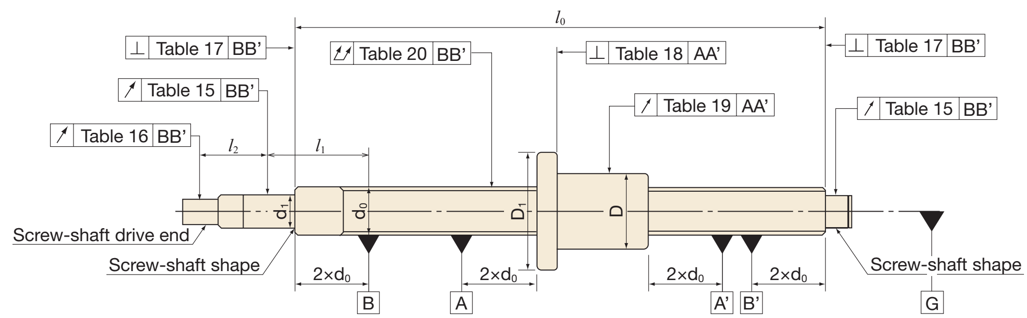


Fig.4 Accuracy of the Mounting Surface of the Ball Screw with grade Cp,Ct

Radial Runout of the Circumference of the Supporting Portion to the Screw Shaft of the Screw Shaft Axis (see Table15)

Table15 Radial Runout of the Journal in Respect to BB'

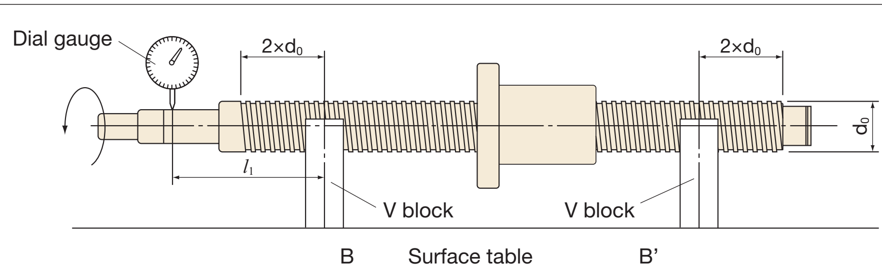
Unit:μm

Screw shaft outer diameter [mm]		l [mm]	Runout (maximum) l_{1p} for l		
Above	Or less		Cp3 Ct3	Cp5 Ct5	Ct7
6	20	80	12	20	40
20	50	125	16	25	50
50	125	200	20	32	63

Note)
Measurement of radial runout, l_1, of bearing diameter related to BB' per length l.
for length $l_1 < l$
For length $l_1 > l$ to be valid

$$l_{1a} = l_{1p} \cdot \frac{l_1}{l}$$

Place the ball screw at point B and B' on V blocks.
Put the dial gauge at the distance l_1 perpendicular to the cylindrical surface.
Rotate the ball screw slowly and record the dial gauge readings.



Radial Runout of the Circumference of the Motor-mounting Shaft-end of the Screw Shaft to the Screw Shaft Axis (see Table16)

Table16 Coaxial deviation of the Journal diameter in respect to the bearing diameter. Ballscrew is placed at the points BB'

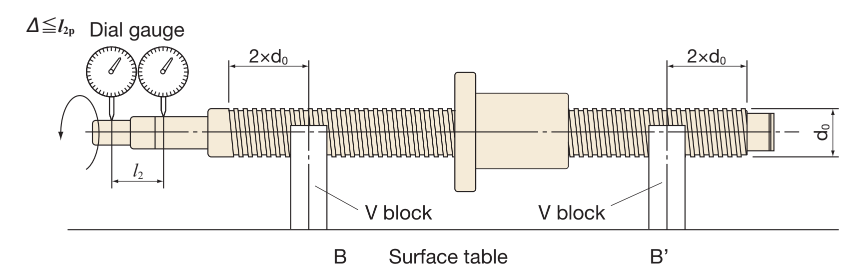
Unit:μm

Screw shaft outer diameter [mm]		l [mm]	Runout (maximum) l_{2p} for l		
Above	Or less		Cp3 Ct3	Cp5 Ct5	Ct7
6	20	80	6	8	12
20	50	125	8	10	16
50	125	200	10	12	20

Note)
Measurement of radial runout, l_2 , of journal diameter related to bearing diameter by determining the difference Δ.
for length $l_2 < l$
For length $l_1 > l$ to be valid

$$l_{2a}=l_{2p}\cdot\frac{l_2}{l}$$

Place the ball screw at point B and B' on V blocks.
Put the dial gauge at the distance l_2 perpendicular to the cylindrical surface.
Rotate the ball screw slowly and record the difference in dial gauge readings.



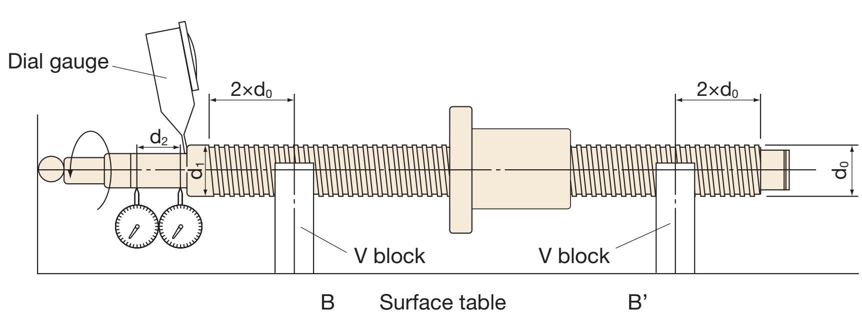
Perpendicularity of the Supporting Portion End to the Screw Shaft of the Screw Shaft Axis (see Table17)

Table17 Perpendicularity of the Supporting Portion End of the Screw Shaft to the Screw Shaft Axis

Unit:μm

Screw shaft outer diameter [mm]		Perpendicularity (maximum)		
Above	Or less	Cp3,Ct3	Cp5,Ct5	Ct7
6	63	4	5	7

Place the ball screw at point B and B' on V blocks.
Secure the ball screw shaft in the axial direction against movement (e.g. by placing a ball between the centers of the ball screw shaft and the mounting surface).
Place the dial gauges perpendicular to the end face of the journal and to the cylindrical surface of the corresponding diameter.
Rotate the ball screw slowly and record the dial gauge readings.



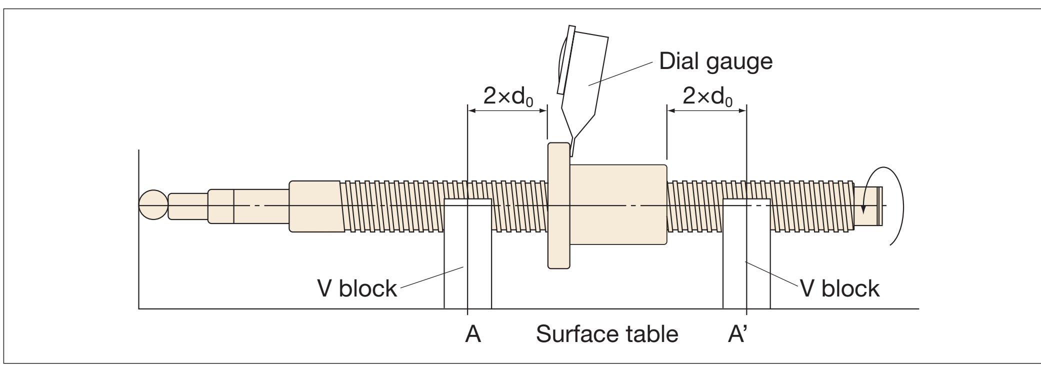
Perpendicularity of the Flange Mounting Surface to the Screw Shaft of the Screw Shaft Axis [for preloaded nut only] (see Table18)

Table18 Perpendicularity of the Flange Mounting Surface of the Screw Shaft to the Screw Shaft Axis

Unit:μm

Flange diameter [mm]		Perpendicularity (maximum)		
Above	Or less	Cp3 Ct3	Cp5 Ct5	Ct7
16	32	12	16	20
32	63	16	20	25
63	125	20	25	32
125	200	25	32	40

For preloaded nut only. Place the ball screw on V blocks at point A and A'.
Secure the ball screw shaft in the axial direction against movement (e.g. by placing a ball between the centers of the ball screw shaft and the mounting surface).
Place the dial gauge perpendicular to the flange face at the outer rim of inspection diameter D_1 .
Secure the ball screw nut against rotation on the ball screw shaft.
Rotate the ball screw shaft and record the dial gauge readings.



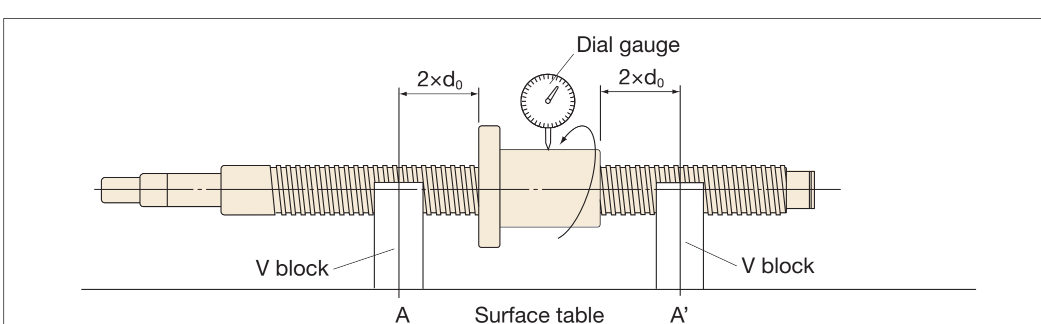
Radial Runout of the Circumference of the Thread Root in Relation to the Screw Shaft of the Screw Shaft Axis [for preloaded nut only] (see Table19)

Table19 Radial Runout of the Circumference of the Thread Root in Relation to the Screw Shaft of the Screw Shaft Axis

Unit:μm

Nut diameter [mm]		Runout (maximum)		
Above	Or less	Cp3 Ct3	Cp5 Ct5	Ct7
16	32	12	16	20
32	63	16	20	25
63	125	20	25	32

For preloaded nut only. Place the ball screw on V blocks at point A and A'.
Place the dial gauge perpendicular to the cylindrical surface of ball nut location inspection diameter D.Secure the ball screw shaft. Rotate the ball nut body slowly. Record the dial gauge readings.



Overall Radial Runout to the Screw Shaft of the Screw Shaft Axis (see Table20)

Table20 Overall Radial Runout to the Screw Shaft of the Screw Shaft Axis

Unit:μm

Screw shaft outer diameter [mm]		l [mm]	Runout (maximum) l_{3p} for l		
Above	Or less		Cp3 Ct3	Cp5 Ct5	Ct7
12	25	160	25	32	40
25	50	315			
50	100	630			

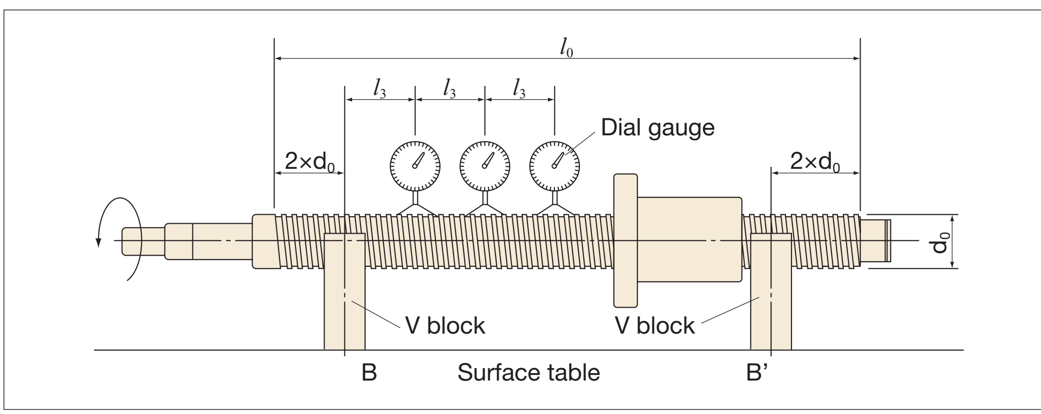
l_0 / d_0		Runout (maximum) l_{3p} for $l_0 \geqq 4 \cdot l$		
Above	Or less	Cp3 Ct3	Cp5 Ct5	Ct7
—	40	50	64	80
40	60	75	96	120
60	80	125	160	200
80	100	200	256	320

Place ball screw on identical V blocks at point B and B'.
Set dial gauge with measuring shoe at the distance l perpendicular to the cylindrical surface.
Rotate the ball screw slowly and record the changes in the dial gauge readings. Repeat the measurement at specified measuring intervals.

For length $l_3 \neq l$ to be valid

$$l_{3a} = l_{3p} \cdot \frac{l_3}{l}$$

Note)
1 Optionally, measurement by supporting used by agreement.
2 If $l_0 < 2 \cdot l_3$, take the measurement at $l_0/2$.



Studying the Service Life

Service Life of the Ball Screw

A Ball Screw in motion under an external load receives continuous stress on its raceways and balls. When the number of stress cycles reaches a limit, the raceways break from the fatigue and their surfaces partially disintegrate in scale-like pieces. This phenomenon is called flaking. The service life of the Ball Screw is the total number of revolutions until the first flaking occurs on any of the raceways or the balls as a result of the rolling fatigue of the material.
The service life of the Ball Screw varies from unit to unit even if they are manufactured in the same process and used in the same operating conditions. For this reason, when determining the service life of a Ball Screw unit, the nominal life as defined below is used as a guideline.
The nominal life is the total number of revolutions that 90% of identical Ball Screw units in a group achieve without developing flaking (scale-like pieces of a metal surface) after they independently operate in the same conditions.

Calculating the Rated Life

The service life of the Ball Screw is calculated from the equation (1) below using the basic dynamic load rating (Ca) and the applied axial load.

Nominal Life (Total Number of Revolutions)

$$L=\left(\frac{Ca}{f_W \cdot Fa}\right)^3 \times 10^6 \quad \cdots\cdots\cdots\cdots (1)$$

L : Nominal life (rev) (total number of revolutions)
Ca : Basic dynamic load rating* [N]
Fa : Applied axial load [N]
f_W : Load factor (see Table21)

* The basic dynamic load rating (Ca) is used in calculating the service life when a Ball Screw operates under a load. The basic dynamic load rating is a load with interlocked direction and magnitude under which the nominal life (L) equals to 10^6rev.
When a group of the same Ball Screw units independently operate. (Specific basic dynamic load ratings (Ca) are indicated in the specification tables of the corresponding model numbers.)

Table21 Load Factor (fw)

Vibrations/ impact	Speed(V)	f_W
Faint	Very low V≦0.25m/s	1 to 1.2
Weak	Slow 0.25<V≦1m/s	1.2 to 1.5
Medium	Medium 1<V≦2m/s	1.5 to 2.0
Strong	High V>2m/s	2.0 to 3.5

Service Life Time

If the revolutions per minute is determined, the service life time can be calculated from the equation (2) below using the nominal life (L).

$$L_h=\frac{L}{60 \times N}=\frac{L \times Ph}{2 \times 60 \times n \times \ell_S} \quad \cdots\cdots\cdots\cdots (2)$$

L_h : Service life time [h]
N : Revolutions per minute [min^{-1}]
n : Number of reciprocations per minute [min^{-1}]
Ph : Ball Screw lead [mm]
ℓ_S : Stroke length [mm]

Service Life Time in Travel Distance

The service life in travel distance can be calculated from the equation (3) below using the nominal life (L) and the Ball Screw lead.

$$L_S=\frac{L \times Ph}{10^6} \quad \cdots\cdots\cdots\cdots (3)$$

L_S : Service Life in Travel Distance (km)
Ph : Ball Screw lead (mm)

Applied Load and Service Life with a Preload Taken into Account

If the Ball Screw is used under a preload (medium preload), it is necessary to consider the applied preload in calculating the service life since the ball screw nut already receives an internal load.
For details on applied preload for a specific model number, contact THK.

Average Axial Load

If an axial load acting on the Ball Screw is present, it is necessary to calculate the service life by determining the average axial load.
The average axial load (Fm) is a constant load that equals to the service life in fluctuating the load conditions.
If the load changes in steps, the average axial load can be obtained from the equation (4) below.

$$F_m = \sqrt[3]{\frac{1}{\ell}\left(Fa_1{}^3\ell_1 + Fa_2{}^3\ell_2 + \cdots + Fa_n{}^3\ell_n\right)} \quad \cdots\cdots\cdots\cdots (4)$$

F_m : Average Axial Load [N]
Fa_n : Varying load [N]
ℓ_n : Distance traveled under load [F_n]
ℓ : Total travel distance

To determine the average axial load using a rotational speed and time, instead of a distance, calculate the average axial load by determining the distance in the equation below.

$$\ell = \ell_1 + \ell_2 + \cdots \ell_n$$
$$\ell_1 = N_1 \cdot t_1$$
$$\ell_2 = N_2 \cdot t_2$$
$$\ell_n = N_n \cdot t_n$$

N : Revolutions per minute [min^{-1}]
t : Time [s]

Static Safety Factor

The basic static load rating (C_0a) is generally equal to the permissible axial load of a Ball Screw. Depending on the conditions, it is necessary to include the following static safety factor when calculating the calculated load. When the Ball Screw is stationary or in motion, unexpected external force may be applied through a load caused by an impact or a sudden start or stop.

$$Fa_{max} = \frac{C_0a}{f_S} \quad \cdots\cdots\cdots\cdots (5)$$

Fa_{max} : Permissible Axial Load [kN]
C_0a : Basic static load rating* [kN]
f_S : Static safety factor (see Table22)

Table22 Static Safety Factor (f_S)

Machine using the LM system	Load conditions	f_S
General industrial machinery	Without vibration or impact	1 to 1.3
	With vibration or impact	2 to 3
Machine tool	Without vibration or impact	1 to 1.5
	With vibration or impact	2.5 to 7

* The basic static load rating (C_0a) is a static load with a constant direction and magnitude whereby the sum of the permanent deformation of the rolling element and that of the raceway on the contact area under the maximum stress is 0.0001 times the rolling element diameter. With the Ball Screw, it is defined as the axial load. (Specific values of each Ball Screw model are indicated in the specification tables for the corresponding model number.)

Dangerous Speed of the Screw Shaft

When the rotational speed exceeds a certain limit, the Ball Screw may resonate and eventually become unable to operate due to the screw shaft's natural frequency. Therefore, it is necessary to select a model so that it is used below the resonance point (dangerous speed).
Fig.5 shows the relationship between the screw shaft diameter and a dangerous speed.
If determining a dangerous speed by calculation, it can be obtained from the equation (6) below. Note that in this equation, a safety factor of 0.8 is multiplied to the result.

$$N_1 = \frac{60 \cdot \lambda_1^2}{2\pi \cdot \ell_b^2} \times \sqrt{\frac{E \times 10^3 \cdot I}{\gamma \cdot A}} \times 0.8 = \lambda_2 \cdot \frac{d_1}{\ell_b^2} \cdot 10^7 \quad \cdots\cdots\cdots\cdots (6)$$

N_1 : Permissible rotational speed determined by dangerous speed [min^{-1}]
ℓ_b : Distance between two mounting surfaces [mm]
E : Young's modulus [2.06×10^5 N/mm^2]
I : Minimum geometrical moment of inertia of the shaft [mm^4]

$$I = \frac{\pi}{64} d_1^4$$

d_1 : screw-shaft thread minor diameter [mm]
γ : Density [specific gravity:7.85×10^{-6}kg/mm^3]
A : Screw shaft cross-sectional area [mm^2]

$$A = \frac{\pi}{4} d_1^2$$

λ_1, λ_2=Factor according to the mounting method

Fixed – free	λ_1 =1.875	λ_2=3.4
Supported - supported	λ_1=3.142	λ_2=9.7
Fixed – supported	λ_1=3.927	λ_2=15.1
Fixed – fixed	λ_1=4.73	λ_2=21.9

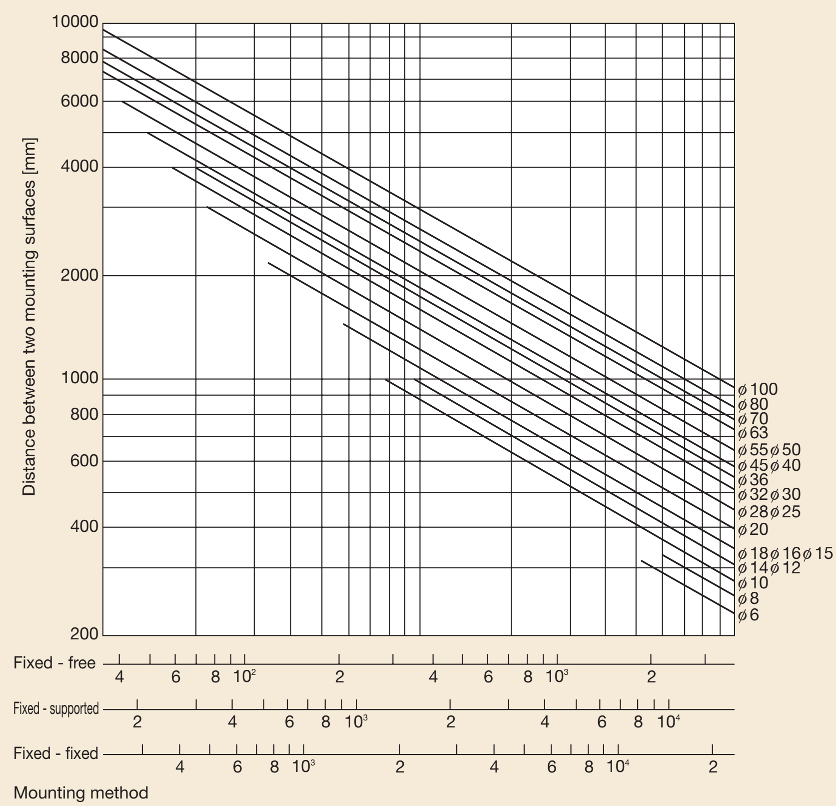


Fig.5 Permissible Rotational Speed Diagram

DN Value

The permissible rotational speed of the Ball Screw must be obtained from the dangerous speed of the screw shaft and the DN value.
The permissible rotational speed determined by the DN value is obtained using the equation (7) below.

$$N_2 = \frac{100000}{D} \quad \cdots\cdots\cdots\cdots(7)$$

N_2 : Permissible rotational speed determined by the DN value [min^{-1}(rpm)]
D : Ball center-to-center diameter [mm]
(indicated in the specification tables of the respective model number)

Of the permissible rotational speed determined by dangerous speed (N_1) and the permissible rotational speed determined by DN value (N_2), the lower rotational speed is regarded as the permissible rotational speed.
If the working rotational speed exceeds N_2, a high-speed type Ball Screw is available. Contact THK for details.

Permissible Axial Load

Buckling Load on the Screw Shaft

With the Ball Screw, it is necessary to select a screw shaft so that it will not buckle when the maximum compressive load is applied in the axial direction.

Fig.6 shows the relationship between the screw shaft diameter and a buckling load.

If determining a buckling load by calculation, it can be obtained from the equation (8) below. Note that in this equation, a safety factor of 0.5 is multiplied to the result.

$$P_1 = \frac{\eta_1 \cdot \pi^2 \cdot E \cdot I}{\ell_a^2} 0.5 = \eta_2 \frac{d_1^4}{\ell_a^2} 10^4 \quad \cdots\cdots\cdots\cdots (8)$$

P_1 : Buckling load [N]

ℓ_a : Distance between two mounting surfaces [mm]

E : Young's modulus [2.06×10^5 N/mm²]

I : Minimum geometrical moment of inertia of the shaft [mm⁴]

$I = \frac{\pi}{64} d_1^4$

d_1 : screw-shaft thread minor diameter [mm]

η_1, η_2=Factor according to the mounting method

Fixed – free	η_1 =0.25	η_2=1.3
Fixed – supported	η_1 =2	η_2=10
Fixed – fixed	η_1 =4	η_2=20

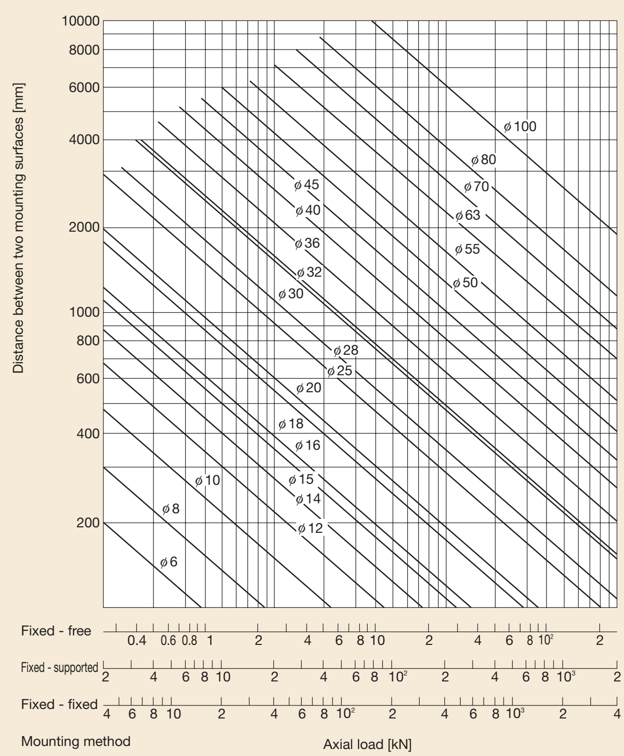


Fig.6 Permissible Tensile Compressive Load Diagram

Permissible Tensile Compressive Load on the Screw Shaft

If an axial load is applied to the Ball Screw, it is necessary to take into account not only the buckling load but also the permissible tensile compressive load in relation to the yielding stress on the screw shaft.

The permissible tensile compressive load is obtained from the equation (9).

$$P_2 = \sigma \frac{\pi}{4} d_1^2 = 116 d_1^2 \quad \cdots\cdots\cdots\cdots (9)$$

P_2 : Permissible tensile compressive load [N]

σ : Permissible tensile compressive stress (147 MPa)

d_1 : Screw-shaft thread minor diameter [mm]

Studying the Rigidity

To increase the positioning accuracy of feed screws in NC machine tools or the precision machines, or to reduce the displacement caused by the cutting force, it is necessary to design the rigidity of the components in a well-balanced manner.

Axial Rigidity of the Feed Screw System

When the axial rigidity of a feed screw system is K, the elastic displacement in the axial direction can be obtained using the equation (10) below.

$$\delta = \frac{Fa}{K} \quad \cdots\cdots\cdots\cdots(10)$$

δ : Elastic displacement of a feed screw system in the axial direction [μm]
Fa : Applied axial load [N]

The axial rigidity (K) of the feed screw system is obtained using the equation (11) below.

$$\frac{1}{K} = \frac{1}{K_S} + \frac{1}{K_N} + \frac{1}{K_B} + \frac{1}{K_H} \quad \cdots\cdots\cdots\cdots(11)$$

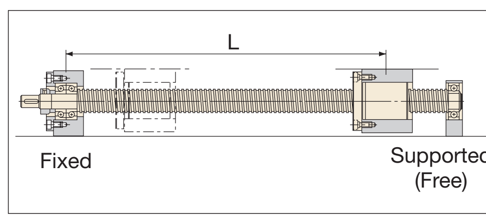
K : Axial Rigidity of the Feed Screw System [N/μm]
K_S : Axial Rigidity of the screw shaft [N/μm]
K_N : Axial Rigidity of the nut [N/μm]
K_B : Axial Rigidity of the support bearing [N/μm]
K_H : Rigidity of the nut bracket and the support bearing bracket [N/μm]

[Axial rigidity of the screw shaft]

The axial rigidity of a screw shaft varies depending on the method for mounting the shaft.

For Fixed-Supported (or -Free) Configuration

$$K_S = \frac{A \cdot E}{1000 \cdot L} \quad \cdots\cdots\cdots\cdots(12)$$



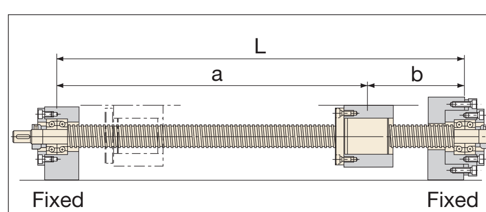
A : Screw shaft cross-sectional area [mm²]

$$A = \frac{\pi}{4} d_1^2$$

d_1 : Screw-shaft thread minor diameter [mm]
E : Young's modulus [2.06×10^5 N/mm²]
L : Distance between two mounting surfaces [mm]
Fig.7 shows an axial rigidity diagram for the screw shaft.

For Fixed-Fixed Configuration

$$K_S = \frac{A \cdot E \cdot L}{1000 \cdot a \cdot b} \quad \cdots\cdots\cdots\cdots(13)$$



K_S becomes the lowest and the elastic displacement in the axial direction is the greatest at the position of $a = b = \frac{L}{2}$.

$$K_S = \frac{4A \cdot E}{1000L}$$

Fig.8 shows an axial rigidity diagram of the screw shaft in this configuration.

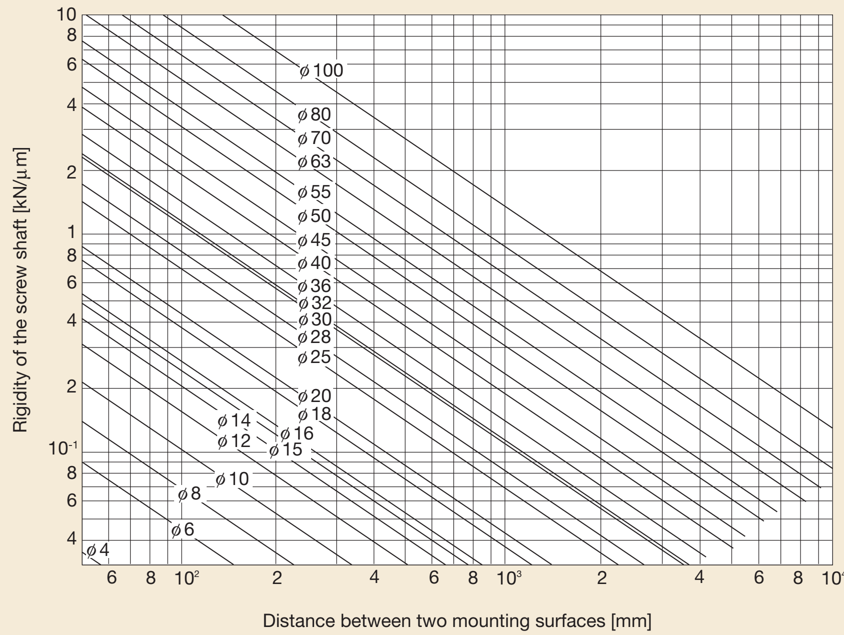


Fig.7 Axial Rigidity of the Screw Shaft (Fixed-Free, Fixed-Supported)

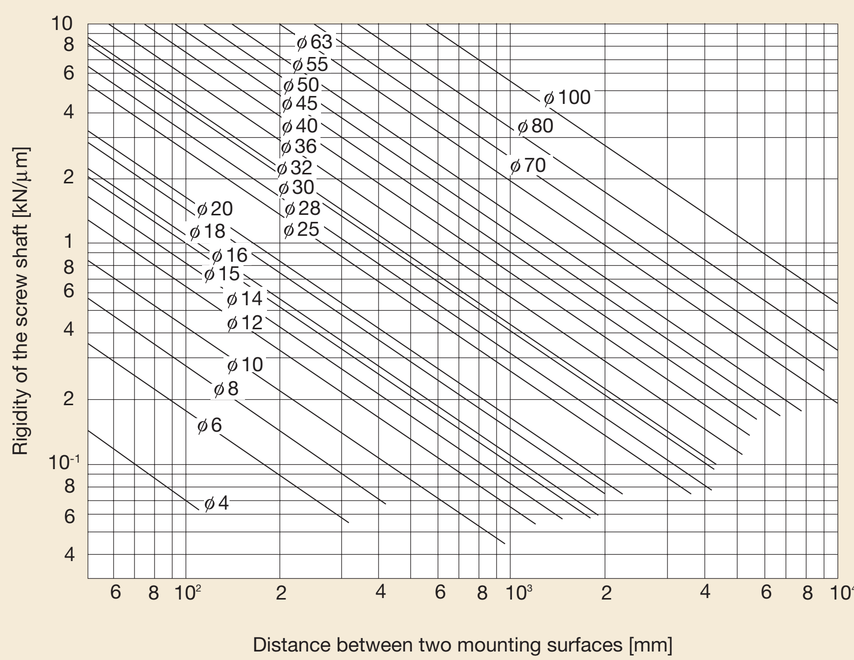


Fig.8 Axial Rigidity of the Screw Shaft (Fixed-Fixed)

[Axial rigidity of the nut]

The axial rigidity of the nut varies widely with preloads.

No Preload Type

The logical rigidity in the axial direction when an axial load accounting for 30% of the basic dynamic load rating (Ca) is applied is indicated in the specification tables of the corresponding model number. This value does not include the rigidity of the components related to the nut-mounting bracket. In general, set the rigidity at roughly 80% of the value in the table.
The rigidity when the applied axial load is not 30% of the basic dynamic load rating (Ca) is calculated using the equation (14) below.

$$K_N = K\left(\frac{Fa}{0.3Ca}\right)^{\frac{1}{3}} \times 0.8 \quad \cdots\cdots\cdots\cdots (14)$$

K_N : Axial rigidity of the nut [N/μm]
K : Rigidity value in the specification tables [N/μm]
Fa : Applied axial load [N]
Ca : Basic dynamic load rating [N]

Preload Type

The logical rigidity in the axial direction when an axial load accounting for 10% of the basic dynamic load rating (Ca) is applied is indicated in the dimensional table of the corresponding model number. This value does not include the rigidity of the components related to the nut-mounting bracket. In general, set the rigidity at roughly 80% of the value in the table.
The rigidity when the applied preload is not 10% of the basic dynamic load rating (Ca) is calculated using the equation (15) below.

$$K_N = K\left(\frac{Fa_0}{0.1Ca}\right)^{\frac{1}{3}} \times 0.8 \quad \cdots\cdots\cdots\cdots (15)$$

K_N : Axial rigidity of the nut [N/μm]
K : Rigidity value in the specification tables [N/μm]
Fa : Applied axial load [N]
Ca : Basic dynamic load rating [N]

[Axial rigidity of the support bearing]

The rigidity of the Ball Screw support bearing varies depending on the support bearing used.
The calculation of the rigidity with a representative angular ball bearing is shown in the equation (16) below.

$$K_B \fallingdotseq \frac{3Fa_0}{\delta a_0} \quad \cdots\cdots\cdots\cdots (16)$$

K_B : Axial rigidity of the support bearing [N/μm]
Fa_0 : Applied preload of the support bearing [N]
δa_0 : Axial displacements [μm]

$$\delta a_0 = \frac{0.45}{\sin\alpha}\left(\frac{Q^2}{Da}\right)^{\frac{1}{3}}$$

$$Q = \frac{Fa_0}{Z\sin\alpha}$$

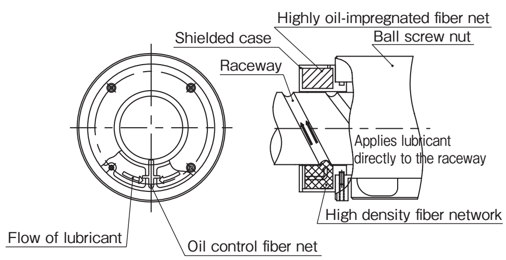
Q : Axial load [N]
Da : Ball diameter of the support bearing [mm]
α : Initial contact angle of the support bearing [°]
Z : Number of balls for details of a specific support bearing, contact its manufacturer.

[Axial Rigidity of the Nut Bracket and the Support Bearing Bracket]

Take this factor into consideration when designing your machine. Set the rigidity as high as possible.

Options

For EB/EP series, QZ Lubricators and Wiper Rings for Ball Screws are available as options. QZ Lubricators which contains a highly oil impregnated fiber net are designed for long term maintenance free operation. Contact type seal, Wiper Ring W, excels in foreign material removal.

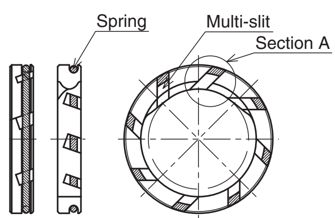


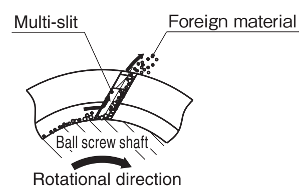
QZ Lubricator

QZ Lubricator is a lubrication system that supplies sufficient lubrication to the raceway of the ball screw shaft.

Wiper ring W

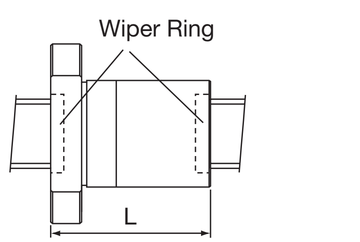
In wiper ring W, a highly wear resistant special resin elastically contacts the circumference and thread groove of the ball screw shaft, and removes foreign material from eight slits, preventing it from entering the ball screw nut.



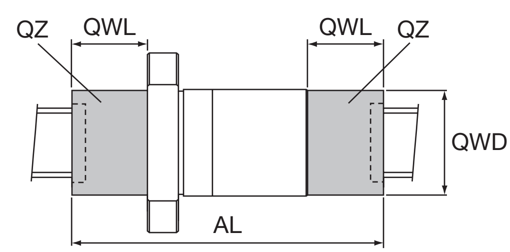


Details of section A

Dimensions of the Ball Screw Nut Attached with Wiper Ring W and QZ Lubricator



With WW (without QZ)



With QZ and WW

Unit:mm

Model No.		Dimensions including WW	Length of protrusion with QZ attached	Outer diameter of protrusion with QZ attached	Dimensions including QZ and WW
		L	QWL	QWD	AL
EBA EBB EBC	1605-4	50	25	27	110
	2005-3	45	26.5	33	98
	2505-3	45	28	39	101
	2510-3	75	32	39	139
	2510-4	80	32	39	144
	3205-3	47	35	45	117
	3205-4	52	35	45	122
	3205-6	62	35	45	132
	3210-3	77	40	49	157
	3210-4	89	40	49	169
	4005-6	65	28.5	61	122
	4010-3	79	44	61	167
	4010-4	89	44	61	177
	4020-3	119	47	61	213
	5010-4	91	37	71	165
	5020-3	124	40	71	204
	6310-6	114	39	84	192
	6320-3	126	30.5	94	187

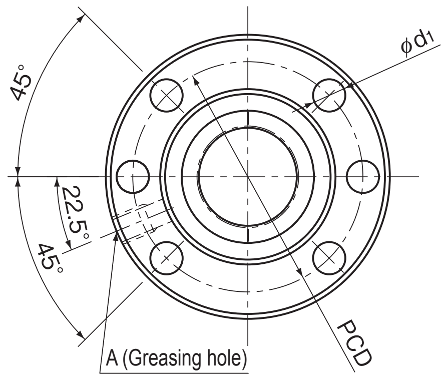
Note) The L dimension indicates the length of the nut with WW.

Unit:mm

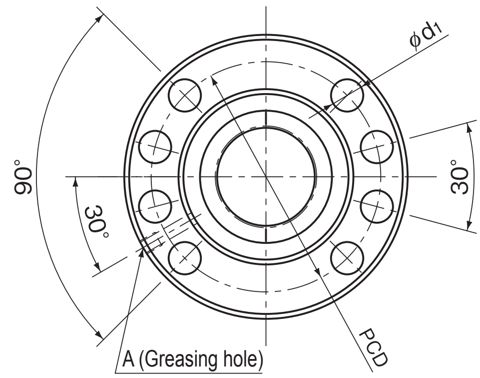
Model No.		Dimensions including WW	Length of protrusion with QZ attached	Outer diameter of protrusion with QZ attached	Dimensions including QZ and WW
		L	QWL	QWD	AL
EPA EPB EPC	1605-6	60	25	27	115
	2005-6	61	26.5	33	114
	2505-6	61	28	39	117
	2510-4	80	32	39	144
	3205-6	62	35	45	132
	3205-8	73	35	45	143
	3210-6	107	40	49	187
	4005-6	65	28.5	61	122
	4010-6	109	44	61	197
	4010-8	133	44	61	221
	5010-8	135	37	71	209
	6310-8	137	39	84	215

Note) The L dimension indicates the length of the nut with WW.

Model EBA (Oversized-ball preload type or non-preloaded type)



Hole type 1
(Model EBA1605 to 3210)



Hole type 2
(Model EBA4005 to 6320)

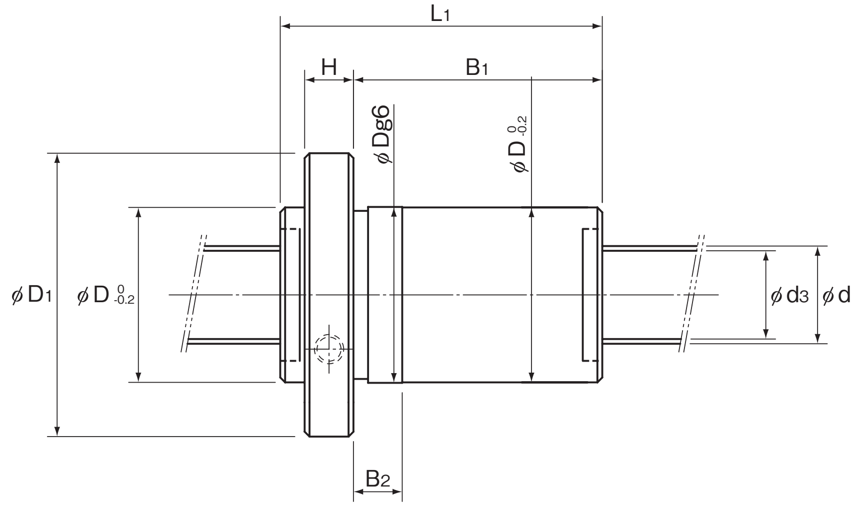
Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	Basic load rating C_0a [kN]	Rigidity K [N/μm]
EBA 1605-4	16	5	3.175	16.75	13.1	4×1	11.9	17.4	210
EBA 2005-3	20	5	3.175	20.75	17.1	3×1	10.6	17.3	200
EBA 2505-3	25	5	3.175	25.75	22.1	3×1	12.1	22.6	250
EBA 2510-3	25	10	3.969	26	21.6	3×1	15.9	27	250
EBA 2510-4	25	10	3.969	26	21.6	4×1	20.9	37.6	330
EBA 3205-3	32	5	3.175	32.75	29.2	3×1	13.9	30.2	300
EBA 3205-4	32	5	3.175	32.75	29.2	4×1	17.8	40.3	400
EBA 3205-6	32	5	3.175	32.75	29.2	6×1	25.1	60.4	600
EBA 3210-3	32	10	6.35	33.75	26.4	3×1	32.1	52.2	300
EBA 3210-4	32	10	6.35	33.75	26.4	4×1	41.3	69.7	390
EBA 4005-6	40	5	3.175	40.75	37.1	6×1	26.6	77.5	716
EBA 4010-3	40	10	6.35	41.75	34.4	3×1	37.3	69.3	380
EBA 4010-4	40	10	6.35	41.75	34.4	4×1	47.6	92.4	500
EBA 4020-3	40	20	6.35	41.75	34.7	3×1	36.8	69.3	750
EBA 5010-4	50	10	6.35	51.75	44.4	4×1	54.3	120.5	610
EBA 5020-3	50	20	7.938	52.25	43.6	3×1	55.3	108.8	470
EBA 6310-6	63	10	6.35	64.75	57.7	6×1	87.9	242.1	1140
EBA 6320-3	63	20	9.525	65.7	56.0	3×1	104.4	229.3	1470

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding

EB A 20 05 -6 QZ RR G0 +650L C3

- 20: Shaft diameter
- 05: Lead
- -6: Number of turns
- G0: Clearance symbol
- C3: Accuracy symbol
- +650L: Ball screw shaft length (mm)
- RR: Seal symbol (RR : Labyrinth seal, WW : Wiper ring.)
- QZ: With QZ Lubricator (no symbol without QZ Lubricator)
- A: Flange shape: A: round; B: double chamfered; C: single chamfered
- EB: Nut type: oversized-ball preload type or non-preloaded type



Unit: mm

Nut dimensions												
Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
28	48	55	10	40	12	1	38	5.5	20	M6×1	0.23	1.25
36	58	50	10	35	12	1	47	6.6	22	M6×1	0.34	2.06
40	62	50	10	35	12	1	51	6.6	24	M6×1	0.37	3.35
40	62	80	10	65	18	1	51	6.6	24	M6×1	0.54	3.45
40	62	85	10	70	18	1	51	6.6	24	M6×1	0.56	3.45
50	80	52	12	35	12	1	65	9	31	M6×1	0.65	5.67
50	80	57	12	40	12	1	65	9	31	M6×1	0.69	5.67
50	80	67	12	50	12	1	65	9	31	M6×1	0.77	5.67
50	80	82	12	65	18	1	65	9	31	M6×1	0.82	4.98
50	80	94	12	77	18	1	65	9	31	M6×1	0.91	4.98
63	93	70	14	51	12	2	78	9	35	M8×1	1.23	9.06
63	93	84	14	65	18	2	78	9	35	M8×1	1.33	8.22
63	93	94	14	75	18	2	78	9	35	M8×1	1.46	8.22
63	93	129	14	105	25	2	78	9	35	M8×1	2.02	9.03
75	110	96	16	75	18	2	93	11	42.5	M8×1	2.05	13.38
75	110	134	16	108	27	2	93	11	42.5	M8×1	2.74	13.8
90	125	119	18	96	18	2	108	11	47.5	M8×1	3.24	21.93
95	135	136	18	108	27	2	115	13.5	50	M8×1	4.42	21.57

Note)The rigidity values in the table represent spring constants each obtained from the load and the Elastic Deformation finish when providing an axial load 24% of the basic dynamic load rating (Ca).

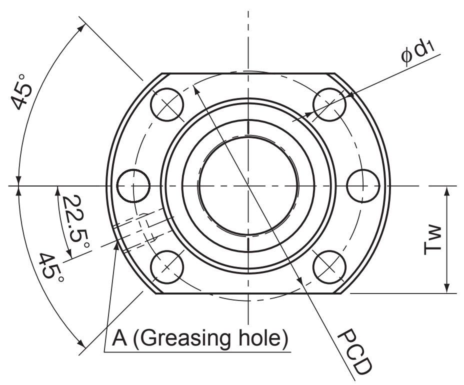
These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.

If the axial load (Fa) is not 0.24 Ca, the rigidity value (K_N) is obtained from the following equation.

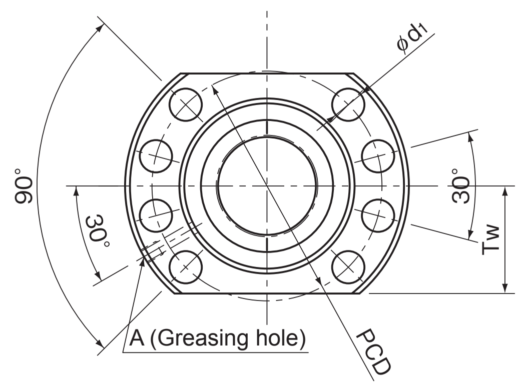
$$K_N = K\left(\frac{Fa}{0.24Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Model EBB (Oversized-ball preload type or non-preloaded type)



Hole type 1
(Model EBB1605 to 3210)

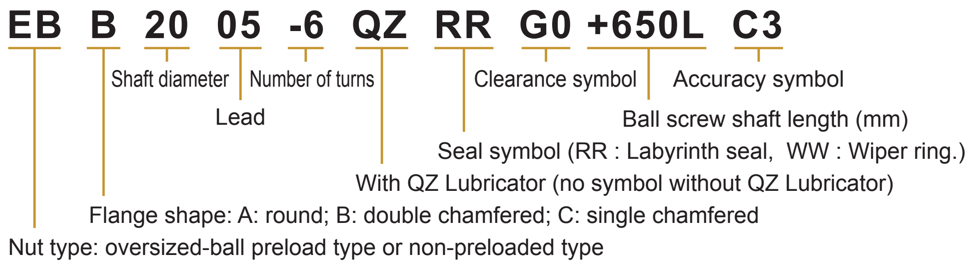


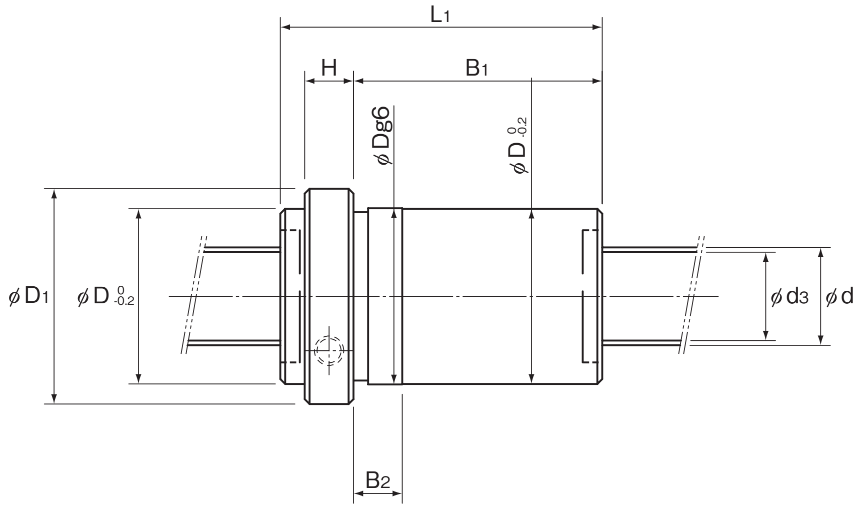
Hole type 2
(Model EBB4005 to 6320)

Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	C_0a [kN]	Rigidity K [N/μm]
EBB 1605-4	16	5	3.175	16.75	13.1	4×1	11.9	17.4	210
EBB 2005-3	20	5	3.175	20.75	17.1	3×1	10.6	17.3	200
EBB 2505-3	25	5	3.175	25.75	22.1	3×1	12.1	22.6	250
EBB 2510-3	25	10	3.969	26	21.6	3×1	15.9	27	250
EBB 2510-4	25	10	3.969	26	21.6	4×1	20.9	37.6	330
EBB 3205-3	32	5	3.175	32.75	29.2	3×1	13.9	30.2	300
EBB 3205-4	32	5	3.175	32.75	29.2	4×1	17.8	40.3	400
EBB 3205-6	32	5	3.175	32.75	29.2	6×1	25.1	60.4	600
EBB 3210-3	32	10	6.35	33.75	26.4	3×1	32.1	52.2	300
EBB 3210-4	32	10	6.35	33.75	26.4	4×1	41.3	69.7	390
EBB 4005-6	40	5	3.175	40.75	37.1	6×1	26.6	77.5	716
EBB 4010-3	40	10	6.35	41.75	34.4	3×1	37.3	69.3	380
EBB 4010-4	40	10	6.35	41.75	34.4	4×1	47.6	92.4	500
EBB 4020-3	40	20	6.35	41.75	34.7	3×1	36.8	69.3	750
EBB 5010-4	50	10	6.35	51.75	44.4	4×1	54.3	120.5	610
EBB 5020-3	50	20	7.938	52.25	43.6	3×1	55.3	108.8	470
EBB 6310-6	63	10	6.35	64.75	57.7	6×1	87.9	242.1	1140
EBB 6320-3	63	20	9.525	65.7	56.0	3×1	104.4	229.3	1470

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding





Unit: mm

Nut dimensions												
Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
28	48	55	10	40	12	1	38	5.5	20	M6×1	0.21	1.25
36	58	50	10	35	12	1	47	6.6	22	M6×1	0.31	2.06
40	62	50	10	35	12	1	51	6.6	24	M6×1	0.34	3.35
40	62	80	10	65	18	1	51	6.6	24	M6×1	0.51	3.45
40	62	85	10	70	18	1	51	6.6	24	M6×1	0.53	3.45
50	80	52	12	35	12	1	65	9	31	M6×1	0.59	5.67
50	80	57	12	40	12	1	65	9	31	M6×1	0.63	5.67
50	80	67	12	50	12	1	65	9	31	M6×1	0.71	5.67
50	80	82	12	65	18	1	65	9	31	M6×1	0.76	4.98
50	80	94	12	77	18	1	65	9	31	M6×1	0.85	4.98
63	93	70	14	51	12	2	78	9	35	M8×1	1.13	9.06
63	93	84	14	65	18	2	78	9	35	M8×1	1.23	8.22
63	93	94	14	75	18	2	78	9	35	M8×1	1.35	8.22
63	93	129	14	105	25	2	78	9	35	M8×1	1.91	9.03
75	110	96	16	75	18	2	93	11	42.5	M8×1	1.90	13.38
75	110	134	16	108	27	2	93	11	42.5	M8×1	2.59	13.8
90	125	119	18	96	18	2	108	11	47.5	M8×1	2.87	21.93
95	135	136	18	108	27	2	115	13.5	50	M8×1	4.11	21.57

Note)The rigidity values in the table represent spring constants each obtained from the load and the Elastic Deformation finish when providing an axial load 24% of the basic dynamic load rating (Ca).

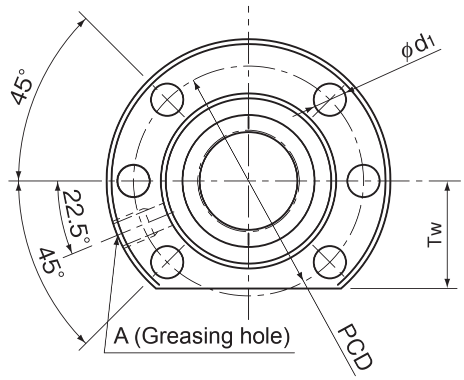
These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.

If the axial load (Fa) is not 0.24 Ca, the rigidity value (K_N) is obtained from the following equation.

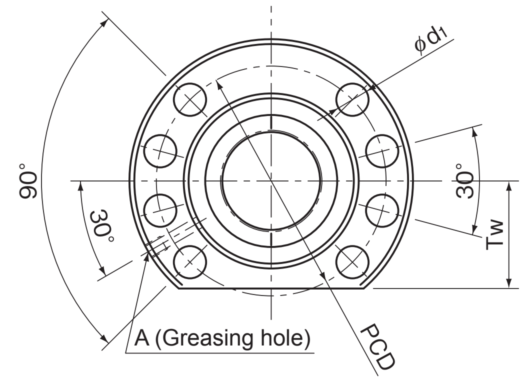
$$K_N = K\left(\frac{Fa}{0.24Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Model EBC (Oversized-ball preload type or non-preloaded type)



Hole type 1
(Model EBC1605 to 3210)



Hole type 2
(Model EBC4005 to 6320)

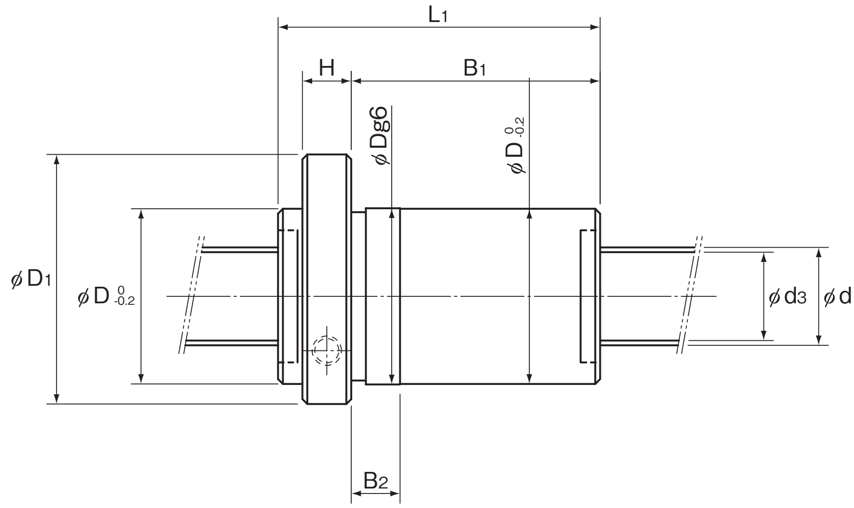
Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	Basic load rating C_0a [kN]	Rigidity K [N/μm]
EBC 1605-4	16	5	3.175	16.75	13.1	4×1	11.9	17.4	210
EBC 2005-3	20	5	3.175	20.75	17.1	3×1	10.6	17.3	200
EBC 2505-3	25	5	3.175	25.75	22.1	3×1	12.1	22.6	250
EBC 2510-3	25	10	3.969	26	21.6	3×1	15.9	27	250
EBC 2510-4	25	10	3.969	26	21.6	4×1	20.9	37.6	330
EBC 3205-3	32	5	3.175	32.75	29.2	3×1	13.9	30.2	300
EBC 3205-4	32	5	3.175	32.75	29.2	4×1	17.8	40.3	400
EBC 3205-6	32	5	3.175	32.75	29.2	6×1	25.1	60.4	600
EBC 3210-3	32	10	6.35	33.75	26.4	3×1	32.1	52.2	300
EBC 3210-4	32	10	6.35	33.75	26.4	4×1	41.3	69.7	390
EBC 4005-6	40	5	3.175	40.75	37.1	6×1	26.6	77.5	716
EBC 4010-3	40	10	6.35	41.75	34.4	3×1	37.3	69.3	380
EBC 4010-4	40	10	6.35	41.75	34.4	4×1	47.6	92.4	500
EBC 4020-3	40	20	6.35	41.75	34.7	3×1	36.8	69.3	750
EBC 5010-4	50	10	6.35	51.75	44.4	4×1	54.3	120.5	610
EBC 5020-3	50	20	7.938	52.25	43.6	3×1	55.3	108.8	470
EBC 6310-6	63	10	6.35	64.75	57.7	6×1	87.9	242.1	1140
EBC 6320-3	63	20	9.525	65.7	56.0	3×1	104.4	229.3	1470

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding

EB C 20 05 -6 QZ RR G0 +650L C3

- 20: Shaft diameter
- -6: Number of turns
- G0: Clearance symbol
- C3: Accuracy symbol
- 05: Lead
- +650L: Ball screw shaft length (mm)
- RR: Seal symbol (RR : Labyrinth seal, WW : Wiper ring.)
- QZ: With QZ Lubricator (no symbol without QZ Lubricator)
- C: Flange shape: A: round; B: double chamfered; C: single chamfered
- EB: Nut type: oversized-ball preload type or non-preloaded type



Unit: mm

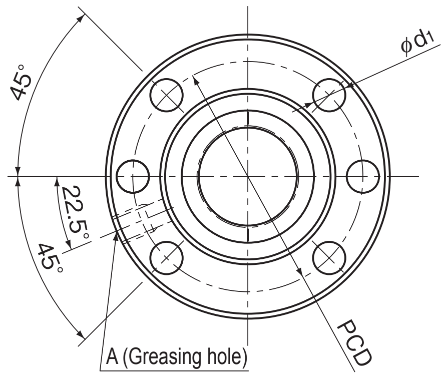
	Nut dimensions												
	Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
	28	48	55	10	40	12	1	38	5.5	20	M6×1	0.22	1.25
	36	58	50	10	35	12	1	47	6.6	22	M6×1	0.33	2.06
	40	62	50	10	35	12	1	51	6.6	24	M6×1	0.35	3.35
	40	62	80	10	65	18	1	51	6.6	24	M6×1	0.52	3.45
	40	62	85	10	70	18	1	51	6.6	24	M6×1	0.55	3.45
	50	80	52	12	35	12	1	65	9	31	M6×1	0.62	5.67
	50	80	57	12	40	12	1	65	9	31	M6×1	0.66	5.67
	50	80	67	12	50	12	1	65	9	31	M6×1	0.74	5.67
	50	80	82	12	65	18	1	65	9	31	M6×1	0.79	4.98
	50	80	94	12	77	18	1	65	9	31	M6×1	0.88	4.98
	63	93	70	14	51	12	2	78	9	35	M8×1	1.18	9.06
	63	93	84	14	65	18	2	78	9	35	M8×1	1.28	8.22
	63	93	94	14	75	18	2	78	9	35	M8×1	1.40	8.22
	63	93	129	14	105	25	2	78	9	35	M8×1	1.97	9.03
	75	110	96	16	75	18	2	93	11	42.5	M8×1	1.98	13.38
	75	110	134	16	108	27	2	93	11	42.5	M8×1	2.67	13.8
	90	125	119	18	96	18	2	108	11	47.5	M8×1	3.05	21.93
	95	135	136	18	108	27	2	115	13.5	50	M8×1	4.27	21.57

Note)The rigidity values in the table represent spring constants each obtained from the load and the Elastic Deformation finish when providing an axial load 24% of the basic dynamic load rating (Ca).
These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.
If the axial load (Fa) is not 0.24 Ca, the rigidity value (K_N) is obtained from the following equation.

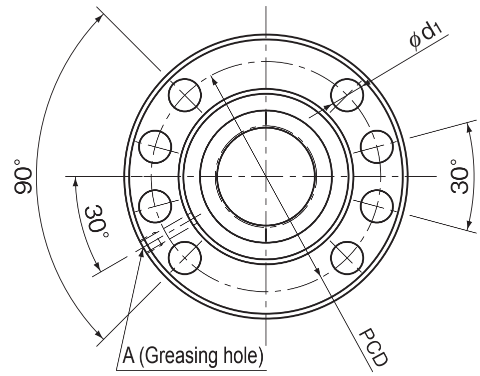
$$K_N = K\left(\frac{Fa}{0.24Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Model EPA (Offset Preload Type)



Hole type 1
(Model EPA1605 to 3210)



Hole type 2
(Model EPA4005 to 6310)

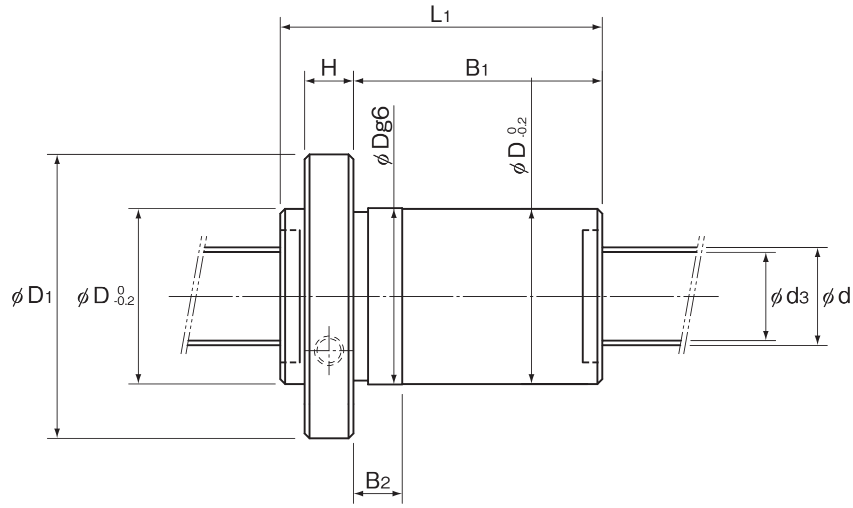
Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	Basic load rating C_0a [kN]	Rigidity K [N/μm]
EPA 1605-6	16	5	3.175	16.75	13.1	3×1	9.3	13.1	317
EPA 2005-6	20	5	3.175	20.75	17.1	3×1	10.6	17.3	310
EPA 2505-6	25	5	3.175	25.75	22.1	3×1	12.1	22.6	490
EPA 2510-4	25	10	3.969	26	21.6	2×1	11.3	18	330
EPA 3205-6	32	5	3.175	32.75	29.2	3×1	13.9	30.2	620
EPA 3205-8	32	5	3.175	32.75	29.2	4×1	17.8	40.3	810
EPA 3210-6	32	10	6.35	33.75	26.4	3×1	32.1	52.2	600
EPA 4005-6	40	5	3.175	40.75	37.1	3×1	15.4	38.8	298
EPA 4010-6	40	10	6.35	41.75	34.7	3×1	37.3	69.3	750
EPA 4010-8	40	10	6.35	41.75	34.7	4×1	47.6	92.4	1000
EPA 5010-8	50	10	6.35	51.75	44.4	4×1	54.3	120.5	1230
EPA 6310-8	63	10	6.35	64.75	57.7	4×1	61.9	160.7	1550

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding

EP A 20 05 -6 QZ RR G0 +650L C3

- EP: Nut type: offset preloaded type
- A: Flange shape: A: round; B: double chamfered; C: single chamfered
- 20: Shaft diameter
- 05: Lead
- -6: Number of turns
- QZ: With QZ Lubricator (no symbol without QZ Lubricator)
- RR: Seal symbol (RR : Labyrinth seal, WW : Wiper ring.)
- G0: Clearance symbol
- +650L: Ball screw shaft length (mm)
- C3: Accuracy symbol



Unit: mm

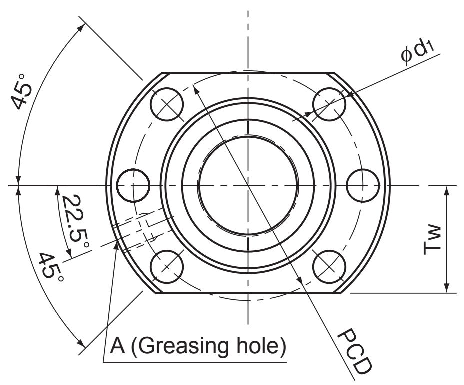
	Nut dimensions												
	Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
	28	48	65	10	50	12	1	38	5.5	20	M6×1	0.25	1.25
	36	58	66	10	51	12	1	47	6.6	22	M6×1	0.42	2.06
	40	62	66	10	51	12	1	51	6.6	24	M6×1	0.45	3.35
	40	62	85	10	70	18	1	51	6.6	24	M6×1	0.56	3.45
	50	80	67	12	50	12	1	65	9	31	M6×1	0.77	5.67
	50	80	78	12	61	12	1	65	9	31	M6×1	0.86	5.67
	50	80	112	12	95	18	1	65	9	31	M6×1	1.03	4.98
	63	93	70	14	51	12	2	78	9	35	M8×1	1.23	9.06
	63	93	114	14	95	18	2	78	9	35	M8×1	1.70	8.22
	63	93	138	14	119	18	2	78	9	35	M8×1	1.99	8.22
	75	110	140	16	119	18	2	93	11	42.5	M8×1	2.77	13.38
	90	125	142	18	119	18	2	108	11	47.5	M8×1	3.74	21.93

Note)The rigidity values in the table represent spring constants each obtained from the load and the elastic deformation when providing a preload 8% of the basic dynamic load rating (Ca) and applying an axial load three times greater than the preload.
These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.
If the applied preload (Fa0) is not 0.08 Ca, the rigidity value (K_N) is obtained from the following equation.

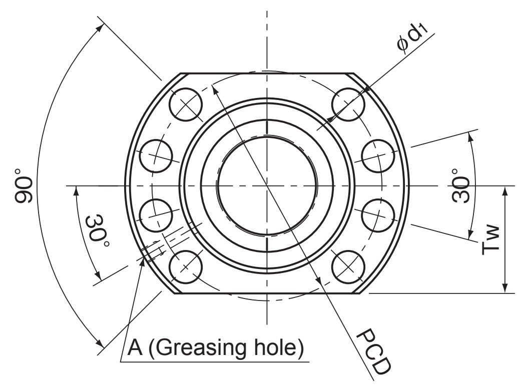
$$K_N = K\left(\frac{Fa0}{0.08Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Model EPB (Offset Preload Type)



Hole type 1
(Model EPB1605 to 3210)



Hole type 2
(Model EPB4005 to 6310)

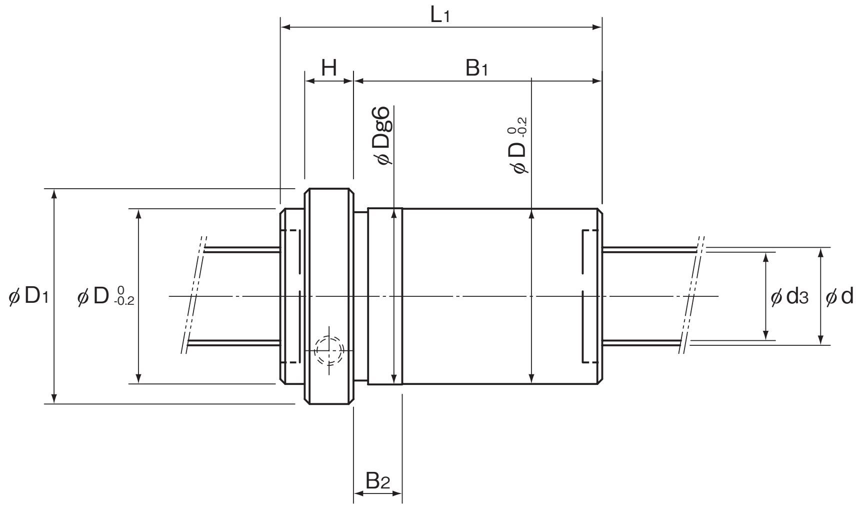
Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	Basic load rating C_0a [kN]	Rigidity K [N/μm]
EPB 1605-6	16	5	3.175	16.75	13.1	3×1	9.3	13.1	317
EPB 2005-6	20	5	3.175	20.75	17.1	3×1	10.6	17.3	310
EPB 2505-6	25	5	3.175	25.75	22.1	3×1	12.1	22.6	490
EPB 2510-4	25	10	3.969	26	21.6	2×1	11.3	18	330
EPB 3205-6	32	5	3.175	32.75	29.2	3×1	13.9	30.2	620
EPB 3205-8	32	5	3.175	32.75	29.2	4×1	17.8	40.3	810
EPB 3210-6	32	10	6.35	33.75	26.4	3×1	32.1	52.2	600
EPB 4005-6	40	5	3.175	40.75	37.1	3×1	15.4	38.8	298
EPB 4010-6	40	10	6.35	41.75	34.7	3×1	37.3	69.3	750
EPB 4010-8	40	10	6.35	41.75	34.7	4×1	47.6	92.4	1000
EPB 5010-8	50	10	6.35	51.75	44.4	4×1	54.3	120.5	1230
EPB 6310-8	63	10	6.35	64.75	57.7	4×1	61.9	160.7	1550

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding

EP B 20 05 -6 QZ RR G0 +650L C3

- EP: Nut type: offset preloaded type
- B: Flange shape: A: round; B: double chamfered; C: single chamfered
- 20: Shaft diameter
- 05: Lead
- -6: Number of turns
- QZ: With QZ Lubricator (no symbol without QZ Lubricator)
- RR: Seal symbol (RR : Labyrinth seal, WW : Wiper ring.)
- G0: Clearance symbol
- +650L: Ball screw shaft length (mm)
- C3: Accuracy symbol



Unit: mm

Nut dimensions												
Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
28	48	65	10	50	12	1	38	5.5	20	M6×1	0.24	1.25
36	58	66	10	51	12	1	47	6.6	22	M6×1	0.39	2.06
40	62	66	10	51	12	1	51	6.6	24	M6×1	0.42	3.35
40	62	85	10	70	18	1	51	6.6	24	M6×1	0.53	3.45
50	80	67	12	50	12	1	65	9	31	M6×1	0.71	5.67
50	80	78	12	61	12	1	65	9	31	M6×1	0.80	5.67
50	80	112	12	95	18	1	65	9	31	M6×1	0.98	4.98
63	93	70	14	51	12	2	78	9	35	M8×1	1.13	9.06
63	93	114	14	95	18	2	78	9	35	M8×1	1.59	8.22
63	93	138	14	119	18	2	78	9	35	M8×1	1.89	8.22
75	110	140	16	119	18	2	93	11	42.5	M8×1	2.62	13.38
90	125	142	18	119	18	2	108	11	47.5	M8×1	3.37	21.93

Note)The rigidity values in the table represent spring constants each obtained from the load and the elastic deformation when providing a preload 8% of the basic dynamic load rating (Ca) and applying an axial load three times greater than the preload.

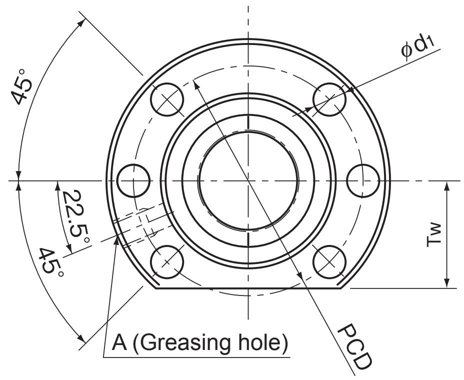
These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.

If the applied preload (Fa0) is not 0.08 Ca, the rigidity value (K_N) is obtained from the following equation.

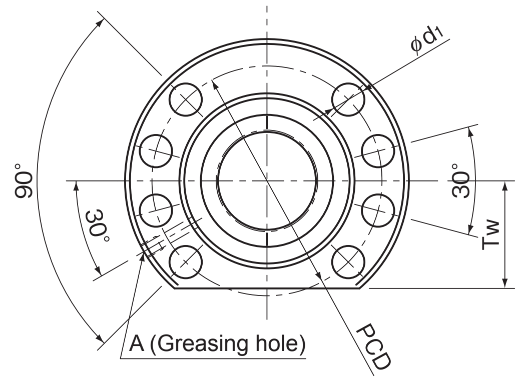
$$K_N = K\left(\frac{Fa0}{0.08Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Model EPC (Offset Preload Type)



Hole type 1
(Model EPC1605 to 3210)



Hole type 2
(Model EPC4005 to 6310)

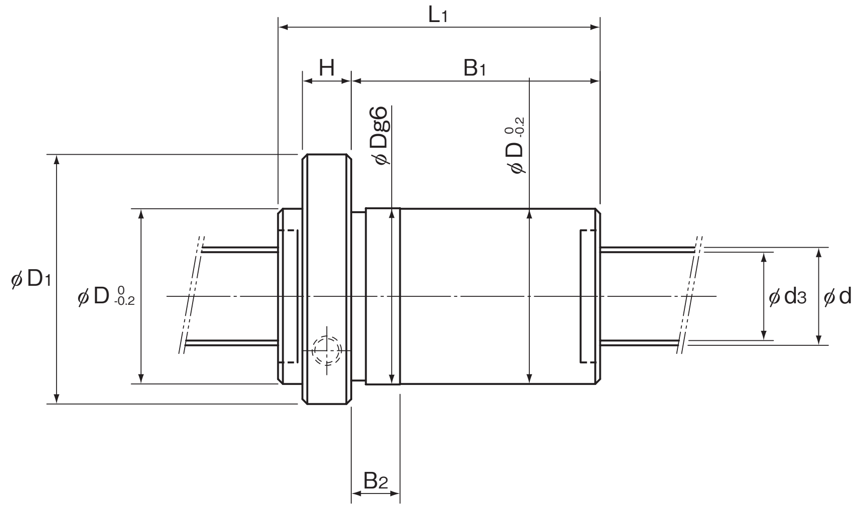
Model No.	Screw shaft outer diameter d	Lead ℓ	Ball diameter Da	Ball center-to-center diameter dp	Thread minor diameter d_3	No. of loaded circuits Rows x turns	Basic load rating Ca★ [kN]	Basic load rating C_0a [kN]	Rigidity K [N/μm]
EPC 1605-6	16	5	3.175	16.75	13.1	3×1	9.3	13.1	317
EPC 2005-6	20	5	3.175	20.75	17.1	3×1	10.6	17.3	310
EPC 2505-6	25	5	3.175	25.75	22.1	3×1	12.1	22.6	490
EPC 2510-4	25	10	3.969	26	21.6	2×1	11.3	18	330
EPC 3205-6	32	5	3.175	32.75	29.2	3×1	13.9	30.2	620
EPC 3205-8	32	5	3.175	32.75	29.2	4×1	17.8	40.3	810
EPC 3210-6	32	10	6.35	33.75	26.4	3×1	32.1	52.2	600
EPC 4005-6	40	5	3.175	40.75	37.1	3×1	15.4	38.8	298
EPC 4010-6	40	10	6.35	41.75	34.7	3×1	37.3	69.3	750
EPC 4010-8	40	10	6.35	41.75	34.7	4×1	47.6	92.4	1000
EPC 5010-8	50	10	6.35	51.75	44.4	4×1	54.3	120.5	1230
EPC 6310-8	63	10	6.35	64.75	57.7	4×1	61.9	160.7	1550

Note)★ Basic Dynamic Load Rating(Ca) of the accuracy C7 and Ct7 is 0.9Ca.

Model number coding

EP C 20 05 -6 QZ RR G0 +650L C3

- EP: Nut type: offset preloaded type
- C: Flange shape: A: round; B: double chamfered; C: single chamfered
- 20: Shaft diameter
- 05: Lead
- -6: Number of turns
- QZ: With QZ Lubricator (no symbol without QZ Lubricator)
- RR: Seal symbol (RR : Labyrinth seal, WW : Wiper ring.)
- G0: Clearance symbol
- +650L: Ball screw shaft length (mm)
- C3: Accuracy symbol



Unit: mm

	Nut dimensions												
	Outer diameter D	Flange diameter D_1	Overall length L_1	H	B_1	B_2	Hole type	PCD	d_1	Tw	Greasing hole A	Nut mass [kg]	Shaft mass [kg/m]
	28	48	65	10	50	12	1	38	5.5	20	M6×1	0.25	1.25
	36	58	66	10	51	12	1	47	6.6	22	M6×1	0.40	2.06
	40	62	66	10	51	12	1	51	6.6	24	M6×1	0.44	3.35
	40	62	85	10	70	18	1	51	6.6	24	M6×1	0.55	3.45
	50	80	67	12	50	12	1	65	9	31	M6×1	0.74	5.67
	50	80	78	12	61	12	1	65	9	31	M6×1	0.83	5.67
	50	80	112	12	95	18	1	65	9	31	M6×1	1.00	4.98
	63	93	70	14	51	12	2	78	9	35	M8×1	1.18	9.06
	63	93	114	14	95	18	2	78	9	35	M8×1	1.65	8.22
	63	93	138	14	119	18	2	78	9	35	M8×1	1.94	8.22
	75	110	140	16	119	18	2	93	11	42.5	M8×1	2.70	13.38
	90	125	142	18	119	18	2	108	11	47.5	M8×1	3.56	21.93

Note)The rigidity values in the table represent spring constants each obtained from the load and the elastic deformation when providing a preload 8% of the basic dynamic load rating (Ca) and applying an axial load three times greater than the preload.

These values do not include the rigidity of the components related to mounting the nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.

If the applied preload (Fa0) is not 0.08 Ca, the rigidity value (K_N) is obtained from the following equation.

$$K_N = K\left(\frac{Fa0}{0.08Ca}\right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

THK DIN Standard Compliant Ball Screws EB series/EP series

⚠ Precautions on use

● Handling

- Do not disassemble the parts. Doing so may allow dust to enter the product and/or cause functional loss.
- Tilting the ball screw shaft and the ball screw nut may cause them to fall by its own weights.
- Do not drop or hit the Ball Screw. Doing so may cause personal injury and/or damage the product. Applying an impact to the product may cause functional loss even if the product looks intact.
- Do not remove the ball screw nut from the ball screw shaft. Doing so may cause balls to fall and make the product inoperable.
- Take care not to allow foreign material such as dust and cutting chips to enter the product. Failure to do so may damage the ball circulation part or cause functional loss.
- Some types of coolants may affect the functionality of the product. If using the product in an environment where a coolant could enter the ball screw nut, contact THK.
- Do not use the product at temperature exceeding 80°C. If the product is attached with QZ Lubricator, be sure to use it at temperature 50°C or below.
- If foreign material such as dust and cutting chips adheres to the product, replenish the lubricant after cleaning the product. For the type of the cleaning fluid, contact THK.
- If using the product for vertical application, take a measure to prevent it from falling such as adding a safety mechanism. Failure to do so may cause the ball screw nut to fall by its own weight.
- Do not use the product at speed exceeding the permissible rotation speed. Doing so may damage the product or cause an accident.
  Make sure that the service rotation speed is within the specification range designated by THK.
- Do not forcefully drive any component into the ball screw shaft or the ball screw nut. Doing so may cause an indentation on the raceway. Take care when mounting components.
- If misalignment or skewing occurs in the ball screw shaft support and the ball screw nut, it may substantially shorten the service life.
  Pay much attention to the components to be mounted and to the mounting accuracy.
- If using the product in a location constantly exposed to vibrations or in a special environment such as a clean room, vacuum, low temperature and high temperature, contact THK.
- Do not let the ball screw nut overshoot. Doing so may cause balls to fall or damage the ball circulation part.

● Lubrication

- Thoroughly wipe off anti-corrosion oil and feed lubricant before using the product.
- Do not mix lubricants with different physical properties.
- In locations constantly exposed to vibrations or in special environments such as a clean room, vacuum, low temperature and high temperature, normal lubricants may not be used. Contact THK for details.
- If planning to use a special lubricant, contact THK before using it.
- Lubrication interval varies according to the service conditions. Contact THK for details.
- In types attached with QZ Lubricator, the required minimum amount of lubricant is supplied to the raceway. Depending on the service conditions such as vertical application, the lubricant may drop from the ball screw shaft due to the nature of the lubricant.

● Storage

- When storing the Ball Screw, enclose it in a package designated by THK and store it in a horizontal orientation while avoiding low temperature, high temperature and high humidity.

- ●The photo may differ slightly in appearance from the actual product.
- ●The appearance and specifications of the product are subject to change without notice. Contact THK before placing an order.
- ●Although great care has been taken in the production of this catalog, THK will not take any responsibility for damage resulting from typographical errors or omissions.
- ●For the export of our products or technologies and for the sale for exports, THK in principle complies with the foreign exchange law and the Foreign Exchange and Foreign Trade Control Law as well as other relevant laws.
  For export of THK products as single items, contact THK in advance.

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